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A MAGAZINE

Devoted to Science, Engineering, and Mechanic Arts,

Especially on the Pacific Coast.



JANUARY TO DECEMBER, 1893.

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JOHN RICHARDS, EDITOR.

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COMMENTS.

Mr. R. P. Rothwell, editor of the *Engineering and Mining Journal*, proposes a solution of the silver problem by an international clearing house, represented by the commercial nations; the proportion, not ratio, between the value of gold and silver to be determined by this monetary bank or bureau, and through branches in the financial centers of the various countries, arrange for the coinage and use of an amount of silver proportionate to the requirements of the several countries, each to be governed by a relative value of the metals fixed by the inter-national bureau. This is merely a "world's agreement," sensible and reasonable in this case and in all other cases, with the distinction that the method seems practicable in monetary matters, while it is not in most other matters. We think Mr. Rothwell's money scheme by all odds the most rational one yet presented.

The Nicaragua canal is now coming more prominently into notice than at any former time, and the general sentiment of the country favors its construction on all grounds that apply to the enterprise, but not on methods or terms that will lend Government money or aid to personal ends. The Senate bill relating to the canal scheme will require a good deal of trimming before it becomes a measure to meet popular opinion, and what will be better, is a

new measure altogether. Any bill originating in the Senate is looked upon with some suspicion. The vast money and corporate interests of the country are represented there by men who, no matter how honest in their opinions, have come to entertain views not consonant with the ideas of equality which should be the ruling spirit of our institutions. The canal constructed under direction of the U. S. Engineer Corps, even if it cost something more than a "contract" price in so far as estimates, would be better done and free from the danger of scandals such as grew out of the Panama scheme. There is not, and has not been, any difficulty in either the construction or management of such Government canal works as exist, the St. Mary and Louisville canals, for example.

The obligatory industrial insurance system of the German Empire imposes quite a tax on manufacturers. The total amount since 1885 is estimated at thirty millions of dollars. The measure is to provide for workmen in the case of sickness or accident, also for old age, and is in extent one of the greatest humanitarian schemes that has ever been tried. *Industries*, London, estimates that the amount absorbed in this insurance system during ten years past has been equal to net profits, and if so, it will not be long until some modification of the laws can be looked for. German manufacturers being protected in their own country by a high tariff, derive their principal gains from their own people, and sell abroad at little or no profit. This places them under some obligation, certainly, and no doubt Bismark had this in view when the insurance law was proposed.

Mr. Watson, of the *Engineer*, New York, clear and candid nearly always, has the temerity to complain of American sewing machines being sold at $45 to South America, and for $80 at home. This is not new. The price of the Wheeler and Wilson sewing machines was in London £6, 10 s., and $75 to $80 at home for a dozen years. This is worse still, and is the natural consequence of "prices by law." The German export trade is built up in the same manner, and when a duty of ten dollars or so was put on steel rails ten years ago, the makers at once added this to the home price, and took off something from the foreign price. If they had not done so, then what was the tariff for? If Mr. Watson has examined a foreign price list of American machinery and hardware, as he no doubt has done, he should know that sewing machines are no exception in this system of dealing.

General Dyrenforth, who we believe is the possessor of a patent on rain bombardment, has been conducting another campaign in Texas, without any other results than those set down as probable by such scientific men as have thought worth while to notice this nonsense. One of our contemporaries suggests the propriety of suppressing both the General, and the Secretary of the Agricultural Department, or at least depriving them of the power of connecting the name of the Government with these rain-making schemes, and this is no doubt the opinion of most people who have thought of the matter at all.

There is nothing rational in railing, neither is it remedy, and it is discouraging to see that this is the principal opposition set up at this day against abuses. We are moved to this thought by column after column and page after page of railing at strikes and labor unions. The premises taken are correct, and the act excusable on ethical grounds, but what is it to accomplish? Also, why is not some of this intellectual energy expended in trying to find out the causes of labor disaffection, and what permits its toleration? There is an animus in all the unreason that exists in pressing preposterous claims for service, and this cause must be either fancied or real. There are two circumstances only that can cause the labor disputes of the time, one, an innate, vicious nature of the workmen, the other a belief in the justice of their demands. It must be one or the other, and until there is some more rational understanding of the matter there will be no reform. As to present remedies, such as profit sharing, they do not deal with the root of the evil at all. All attempts to "combine" capital and labor will increase the difficulty. They should, on the contrary, be separated, each put on its own basis, and each made responsible in their own field.

The executive committee of the National Centennial Patent Convention, which met at Washington in April last, have issued in pamphlet form the address of the chairman, Robert W. Fenwick, Esq., of the firm of Messrs. Mason, Fenwick & Lawrence, now a member of the central committee. This address comprehends an interesting history of the rise and progress of the Bureau, throughout nearly a century, also pregnant suggestions respecting the present and future in regard to the lack of room and facilities to transact the business presented. Mr. Fenwick has spent nearly the whole of his active life in connection with the Patent Office, and of his

own knowledge can cover a good share of its period in this history, and speak with a full understanding of its requirements, uses and possibilities. We speak of Mr. Fenwick from an acquaintance of thirty years, dating from 1863, and to the merits of his address can add testimony of the many suggestions and improvements he has made in the Bureau's procedure. The pamphlet is mailed on application, to those who desire to know the history of this important branch of our industrial economy.

One in looking over present circumstances may well conclude that our newspapers and public men could be spending their efforts to better advantage than in describing the decadence of British industry, suffering in Wales, and other hash of that kind. It would, for instance, be better to give some attention to British operations on this continent, such as canal ways from the Great Lakes to the Gulf of St. Lawrence, and a still more important scheme, now clearly in view, to direct from New York a great share of the traffic between there and Liverpool to some port north of the United States. They have a sea journey 36 hours shorter in their favor, and the only complete transcontinental railway line, finely equipped, and even now competing for our inland commercial carrying trade. This we think would, in the end, be more profitable than hunting out internal troubles in Great Britain, when we have quite enough at home to engage our efforts.

The U. S. Commissioner of Railways, the Hon. A. Taylor, in a report to the Secretary of the Interior, recommends that the debts of the Pacific Railways be extended for payment 100 years at two per cent. interest. It would be more candid to recommend that the debt be canceled. We have nothing to do with a hundred years hence, and certainly have no claims to wisdom at this day that suggest legislation for posterity. The whole matter simply stated is, that the beneficiaries of these Government grants do not intend repayment, and there is a lack of power or sagacity, or both, on the part of the Government to deal with the case. Had the promoters of these railways gained no more than moderate earnings, the case would be different, but they have drawn fabulous wealth from the property thus created, beside which the money advanced to them is a trifling sum, and this one-hundred-year proposal is but a mockery and is dishonest.

The *Nation* pointed out recently, in respect to the Brussels' Monetary Congress, that one impediment under which our representatives appeared there, was the fact that our National policy in respect to currency is a political one, decided by popular vote, and that this state of things does not apply to any other country, not even in the smallest degree. This is unfortunately true. We say unfortunately, because of all things in the economy of a government nothing is less adapted for decision by a vote, than matters of finance. There is no popular understanding of the subject in this or any other country, that warrants voting upon it.

One of the most important facts in our present system, and one bearing directly upon the subjects discussed at the Brussels Conference, is the purchase of 4,500,000 ounces of silver per month by the United States Government, a measure that is political if anything; condemned by every financier of repute in this country, even by the author of the law. It would be a fortunate matter if all problems of money and currency could be removed from the field of politics as they should be, and left to some authority competent to deal with so complex a subject. In the British Parliament there are not five members that would dare to rise and speak before that assemblage on a subject of finance, and as all know, such subjects as currency and money, or even National finance, is not discussed at all.

In the communication, printed elsewhere in this number, is foreshadowed a phase of "land building" that has sooner come about in marine building. The parallel is easily drawn. The introduction in modern ships, of what may be called the engineering part, consisting of complicated systems of power distribution for lighting, signaling, ventilation, firing, propelling, and so on, has divided the art of shipbuilding between the naval constructor and the engineer, with the greater share to the latter. In building on land this change has not come about in the same degree. Although buildings are equipped much as ships are, the plans are left to be worked out mainly, or almost wholly, by the architects, and the result is much the same as though the naval architect would undertake to design and arrange the propelling, electric and hydraulic elements of a modern vessel. It is, perhaps, not too much to claim that the ships are much ahead, for the reason that there is a greater division of skill in their construction. "Thermo's" propositions are tenable and timely.

A phenomena of our day is what may be called a decadence of British patents. It is despairing to go over the Official Journal, and see the number of silly and useless things forming the subject of patent grants in that country. This is the more singular in view of the fact that ten years ago British patents, in their import and value, stood higher than in this country, in other words, there were less and better patents. This is not the case now, and there is also a marked difference in our favor when the Patent Office publications are compared. The drawings, paper, print and general dress of the whole, as well as subject matter, is better in the United States.

We note, among news announcements, that, in several cases, wages have been advanced since the late election, notably by the Lowell cotton mills, which includes thousands of workmen. A resolution was passed authorizing a raise of not more than 7 per cent from Dec. 4. The Lonsdale Company, of Providence, R. I., notified their employed force that there would be an advance in wages of 5 per cent. in December. The Blackstone Company, of Blackstone, Mass., also decided to advance wages 5 per cent., in December. These items are taken from a reliable source, and indicate how little political maneuvering has to do with wages. At the same time comes from Germany a report on wages there, showing that the rate varies 100 per cent. within short distances, where cities are compared with mountain and village districts, but, strangest of all is that the German manufacturers ask "how are we to compete with England when they can afford to pay 50 per cent. more wages than we do?" All over the world cheaper production follows the higher wages, or, in other words, the efficiency of workmen becoming a measure of wages.

U. S. Consul General Goldschmidt, at Vienna, Austria, has been enlightening his countrymen with some information respecting Austrian and other European patents, claiming that American applicants have to pay $100 for an Austrian patent that should cost $18. This is on a par with a good many other things written about by those who do not themselves understand the subjects dealt with. In the first place an Austrian patent is taken out from San Francisco for $60 to $70, not $100, and this is no doubt something more than the fees charged in the Eastern States, and if Mr. Goldschmidt was in the business, we imagine his fees would be about $500, but that aside, the government fees in Austria are about $20, but how is the

patent application to be prepared, translated, filed, recorded and watched throughout its term? Even here at home where the government fees are $35, no one cares to prepare, present, and prosecute a case for less than an equal amount, and cannot do it at that rate, in the manner it should be done in most cases. The Consul General's information is no doubt from some Austrian patent attorney, who wants the fees lowered here so as to increase his own. Efficient prosecution of patent cases, is the worst paid of any professional work of the kind.

The London building trades, which include carpenters, masons, plumbers, painters, decorators, and others, after the 7th of November last, will work on an average a little more than 48 hours per week, or six hours less than the hours here. Whatever other comment the circumstance admits of, it is certainly a refutation of the "pauper labor" cry of which we have heard a good deal. It means, no doubt, an enhanced cost of building, perhaps not in proportion to the reduction in hours, but near it, because the former hours were not long enough to impair a workman's efficiency. Then again, it may not cause an absolute increase in the cost of building, because compensated by improved methods, in which the workmen claim their share.

The Inter-colonial Railway management, in Canada, announces that the general freight agent, general passenger agent and chief mechanical superintendent are placed on the "retired list." "By this," says the *Railway Age*, "it is apparent that the Canadian Government does not turn its faithful railway servants out of doors when they have passed their prime, and when younger men are wanted in their places." Little by little we learn in this country that the laws of human economy are the same everywhere, and that the teachings of centuries of experience in older lands are not to be ignored. One of these lessons must be that the obligations for long and faithful service are not discharged by a salary alone, or to state it in another way, long and faithful service cannot be obtained for wages alone. In the present system of turning superannuated people out to starve, lies a potent cause of much that is wanting in our civil and other public service, and it is out of this unjust system that comes inefficient and dishonest service. A rotation of office, civil, military, or otherwise, is irrational and demoralizing, and the wonder is that we have gone on so long without the obvious and common means of securing faithful service.

The clamor for reduced railway rates to the World's Exhibition, next year, has been met on the part of the railways, by the claim that other kinds of public service, such as hotels, should be reduced accordingly. There have been a good many attempts, not very successful, to show the unreason of this proposition, but the fact is that no sufficient answer can be framed. We visited the Vienna Exhibition in 1873, and at Pragne, on the way there, were informed that no hotel accommodations existed at Vienna, and that rates were "fearful." This was set down as a lie, and proved one by the fact of hiring a good room in a new hotel, near the exhibition, in Vienna, for three florins, ($1.20) a day, and paying less for meals than in Berlin or London. At Philadelphia, in 1876, the city was turned into a vast hostlery. Rooms for which five dollars a day was demanded, at the opening of the exhibition, were let at one dollar a day within a fortnight. Thousands of "cots," bought and set up in private houses to accommodate the expected throng, were sold at a fearful discount ten days later. At two of the Paris Exhibitions we paid normal rates, or even less for accommodation, and the hope is that Chicago will learn the lesson of disappointed extortion in the same manner. A hotel that will increase its rates because people are obliged to patronize it, should be shunned, then and in future.

INDUSTRIAL NOTES.

At the winter meeting of the Mechanical Engineers in New York, ending Dec. 2d, the following papers were read :

Tests of a Triple Engine	by Messrs. Peabody and Miller.
Negative Specific Heat	" De Volson Wood.
Cutting Cams	" W. A. Gabriel.
Shaft Governors	" F. M. Rites.
Strains in Lathe Frames	" G. W. Bissell.
Refrigeration	" G. Richmond.
Strains in Fly Wheels	" J. B. Stanwood.
Hydraulic Motors	" De Volson Wood.
Driving Bands	" Samuel Webber.
Recording Gauges	" W. H. Bristol.
Heat of Lamps	" D. S. Jacobs.
Overhead Crane	" Victorin Anthony.
Propeller Efficiency	" W. F. Durand.
Steam Radiator	" J. T. Hawkins.
Engine Governing	" R. C. Carpenter.

These papers will be again noticed when revised copies are prepared and sent out.

We have several times urged the makers of gas engines here to give attention to the continuous impulse plan, in which there is an explosion at each revolution. This method keeps advancing, and now the British Gas Engine Co., makers of the Atkinson cycle engines, have began making a continuous engine, and this being one of the most prominent firms engaged in the business, indicates success of the system. The economic effect is not only in doubling the efficiency in proportion to the size of an engine, but an increased steadiness of the power, and reduction of the weight of the fly-wheels required. The company named do not wholly depend upon the pistons clearing the cylinders of spent gas on the inward stroke, as in the Day engine, but admit a partial charge of new gas to assist in expelling the spent charge.

The Cramp Shipbuilding Company, at Philadelphia, have constructed a floating crane on a pontoon, $69 \times 62 \times 13$ feet, built in compartments, that is one of the most remarkable structures of the kind ever designed. The central mast is in all over 100 feet high, the boom being about midway. To prevent the pontoon from tilting when a load is lifted, water is admitted to the opposite side as fast as the load is taken on the boom, and is pumped out as the load is released. The adaptability of a portable crane of the kind is a great point in its favor. Different vessels can be served without moving them, or the crane can be taken to a sunken vessel. Even for stationary work the counterpoise of water does not cost much to handle, and saves expensive foundations.

The Lidgerwood Manufacturing Company, of New York, propose to mount an engine on the forward car of a gravel or construction train, and by means of winding gearing, driven by steam from the locomotive boiler, "plow off" the material from the loaded cars instead of dumping them in the usual manner. This may have an economic point in enabling the use of common platform cars for construction purposes, and we imagine ends there. A dumping car comes as near filling the required functions as is possible, and does not call for a winding engine, and a fluke plow that will weigh as much as a car load of ballast, and occupy a couple of cars beside. A fill made in this manner would require the track to be shoveled clear after each trip. The discharge at an angle away from the cars, such as the dumping method gives, is an essential feature of the operation in most, but perhaps not all cases.

A firm in New Jersey are making single-geared circular saw mills, the engine being connected directly to the saw spindles. The idea is not new. The Buckeye Engine Co., of Salem, Ohio, twenty-five years ago, made such saw mills as a regular article of manufacture, and of a much better design than this later one. The engines were laid horizontally so their vibration could be better resisted, and were removed to a convenient distance from the saws. In talking to an engineer in charge of one of these mills, twenty years ago, he said "I have no trouble unless something about the engine gets away, and the best place to hunt for it is in the next township." Next to an engine designed by the late John Ericsson to drive a dynamo in the Delemater Iron Works, New York, these Buckeye engines were the best adaptation for high speed we have ever seen. The Ericsson engine, as now remembered, ran at 1,200 revolutions per minute.

We mentioned, last month, the investigation of the subject of steam jackets by a committee of the Institute of Mechanical Engineers, London, and promised farther notice of the results. In one experiment at a thread works the saving was 2.5 per cent. We quote the following summary from the tables, and will give the final summing up of the report when it appears :

"If q is the percentage saving in feed water—that is, the percentage less feed water resulting from the use of the jackets; p the actual saving in pounds per I. H. P. per hour; and r the water condensed in the jackets in pounds per I. H. P. per hour; then by an expenditure of r in the jackets there is $p + r$ less water passed through the cylinder, p being the credit balance of the account. The following examples are taken from the tables :

a	q	$p + r$	r	Ratio $p + r$ to r
No.	Per cent.	lb.	lb.	
41	17.4	6.15	3.29	1.9 to 1
42	8.6	2.76	1.20	2.3 " 1
43	10.3	3.50	1.72	2.0 " 1
44	19.0	5.82	1.13	5.2 " 1

No. 44 shows that for every 1.13 lb. of steam expended in the jackets, there is 5.82 lb. feed water passed through the cylinder, the net saving being thus 4.69 lb."

The Prince of Monaco, the little Republic in Italy celebrated for its smallness and notorious for its gambling, has done a very useful thing in determining ocean currents by having thrown overboard from vessels, in various parts of the world, sealed packages to be returned to him in case they came to land, and were picked up. These packages are bottles encased in copper, and the whole number used this far is 1,670, during a period of ten years. Of these 226 were picked up, and returned to the Prince with notes of the position where they were found. The experiment is to be continued, and will show beyond question the course of currents at the surface. The speed at which the packages floated is supposed to be about four miles a day in the principal currents. Many princes have done things less useful and commendable.

Mr. Bowie, a practical engineer, in a lecture on combustion, delivered in Chicago recently, said in respect to steam jets :

"The idea that steam applied in this way makes water gas, and is of more value than pure air is nonsense, and no one but a prejudiced party, or one dense in ignorance, would for a moment stand by such a statement. The oxygen of the water is already with its strongest affinity — hydrogen. Why should it leave it? The jet, like everything else connected with smoke appliances, can not be applied by any one who knows his work too well. Its efficiency and economy depend on its being done right."

While there is scarcely room for opinions in a case coming so clearly within the laws of combustion, and the chemical reactions that take place, we must strongly suspect that Mr. Bowie is correct, and that an air jet is much better than one of steam. It is not easily obtainable, however, while the steam is ready at hand.

The plans now favored by the Canadian Power Company, at Niagara, are substantially the same as those presented by the Pelton Water Wheel Company, of this City, before the London commission last year, and, in so far as a scheme for electrical transmission, is, we think, much better and cheaper than the plans this far adopted on the American side, in fact will cost only one half as much. The natural conditions are more favorable on the Canadian side, besides do not involve a land scheme in addition to a power one, so the waste tunnels are only from 800 to 1,000 feet long. It is proposed to excavate and line a cylindrical chamber large enough in diameter and long enough to contain a number of units, consisting of Pelton

water wheels of ten to fourteen feet in diameter, having armatures mounted directly on the same shafts. There will be a metal framework covering the wheels and dynamos, with travelling cranes overhead, a drain way, and an arched passage beneath, so there is not a single detail of the machinery but what is in sight, and accessible at all times. There is, moreover, no experiment in the plans as there is on the American side, where a good many things may give trouble.

The trans-Andine railway across the Andes, to connect Buenos Ayres, on the Atlantic, with Valparaiso, on the Pacific Ocean, has been completed, except 42 miles at the summit. In one case there are sixty bridges required in a little more than 100 miles, and most of these bridges were constructed in this country against competitive bids in England, mainly because of the time required. The English builders wanted eight months, and the American firms eight weeks, a wide difference. The bridges were constructed by the Phoenix Iron Works, near Philadelphia, where there is an enormous plant, and an organized system of working different from anything of the kind in Europe. There each bridge is a special design worked out by an engineer, and sent to a contractor. Here bridges are made of an uniform type. A good design is decided upon, and the makers work to that design, furnishing bridges by the piece, or by the yard, as one might say. There is no objection to this in so far as the quality of bridges, and a considerable advantage is gained in their cost, but it centralizes the industry and cuts off competition.

The Dunham, Carrigan & Hayden Co., of this City, have just published what they call a catalogue, which deserves a technical instead of a trade notice. It contains 475 quarto pages, printed on fine paper, at a publishing cost alone exceeding three dollars per copy. The book is arranged in five divisions to secure classification of the various commodities that, on this Coast, come under the head of "hardware," including machine tools and all implements that enter into general trade. The main feature of the work is its classification, on which depends its value as a book of reference. Different things follow in the sequence of their use, or in what may be called consecutive functions, so that an index is scarcely required. Mr. Buckley, of the Company, to whom the compilation was entrusted, has succeeded in producing for the first time, so far as we know, a truly systematic work of the kind, one that will be invalu-

able as a reference to engineers and manufacturers. The position and functions of a firm dealing in engineering and industrial supplies on this Coast is different from what it is in the Eastern States, where the same business could be divided into several branches, hence the requirement for such an extensive reference catalogue.

LOCAL NOTES.

The last number closing the fourth yearly volume of INDUSTRY, made up 954 pages of reading matter, of which not more than one twentieth part was reprinted from other serials, or "stock matter." The present number contains the first of a series of copyright articles to be reprinted from *Cassier's Magazine*, a publication that stands at the head of its class in all qualities that give "furtherance" to serial literature of the highest class. It was our privilege at the time this Magazine was founded, to make some claims in its favor that have been more than borne out by subsequent facts. Referring further to INDUSTRY, its character has to be like that of the industrial establishments of this Coast. The field is too narrow for a division of subject matter, so a journal of this kind must embrace, like Teufelsdröckh's curriculum, "the science of things in general." (*Gameinlichwissenschaft.*) This fact our indulgent readers understand, and to kindly criticism there is this answer, that INDUSTRY is like Professor Sweet's engines, "the best we know how to make," and so enter on another year in confidence.

The Golden Gate and Miners Iron Works, of this City, have in process of construction, and will exhibit at Chicago, one of Thompson's patent compound engines, of 250 horse power. This engine will drive a portion of the Exhibition, and the exhibit is in every way creditable to the Company's enterprise. They have just completed a steel "clamshell" for dredging processes, weighing 6,400 pounds, constructed on a new and more simple method than usual. The closing chains are carried over sectors set centrally and formed integrally with the jaw levers, so there are no wearing or even working joints, except the main hinge of the shells. It has all the functions of the common design, and about one half the pieces, and is, we imagine, a final design for these buckets. The Miners Iron Works seem just now to be engaged in the creditable enter-

prise of "casting out parts and pieces." We note on the floor a large friction clutch that is a study of simplicity. The jaws are opposite and balanced, mounted on double flexible arms that perform three functions, namely: support the jaws, act as drivers, and as release springs, without involving a sliding joint of any kind. The jaws are closed by bell cranks and links of the most simple construction. There are all the adjustments and functions of the grip clutches made in the East, and less than half the number of parts.

Our neighbors of Oakland have, with nice discrimination, concluded to separate the organic matter and solids from their drinking water, which reminds one of a cynical remark in one of the New York papers some years ago, that Philadelphians were a particular people who always removed the shells of oysters before eating them, and threw the shells in the streets to keep the premises tidy. It is not the "fact" of straining Oakland water that calls for remark, it is the manner of it, which, we are informed, will consist in setting in the bottom of tanks funnel-shaped receptacles of iron with perforated copper screens on top, then a layer of lead shot, and then another copper screen beneath the shot. These screens are held in one case by brass screws, and the other by iron screws. This arrangement has a double function. It offers mechanical obstruction to such impurities as cannot be swallowed, and is also a tolerably good galvanic battery. The electrolytic process, thus set up, will include the arsenic in the shot, and the whole will, no doubt, furnish an augmented field for pathological practice in Oakland.

Mr. W. T. Y. Schenck, of this City, informs us that he is to fit into the California Building, at the World's Exhibition, fourteen of his hose reels for fire purposes, and we make the circumstance a reason for saying that this expedient of a "ready" fire hose is the most important addition to fire prevention that we have had for twenty years past. Water and a hose has long been the common means of extinguishment, but a hose that has to be hunted up, unreeled and screwed on, is of little use in the hands of a watchman, or, indeed, any one in case of excitement. With this new reel attachment the hose remains connected, and the water starts through while the hose is on the reel. There is nothing to do but turn a cock and lead the hose to where the water is required. Any one will do that, under any circumstances, but can not "screw

on" a hose. This is not very easy to do even when there is no fire or excitement. The Union Iron Works employ a similar device for conveying air pressure to their girder cranes, adopted after the failure of some other methods.

The contracts for the cruiser *Brooklyn* and the battle-ship *Iowa* will no doubt be awarded to the Cramp Company, at Philadelphia, which bid for the *Brooklyn* $2,986,000, and for the *Iowa* $3,100,000. The Union Iron Works' bid was $3,050,000 for the *Brooklyn*, and $3,150,000 for the *Iowa*, the difference being $64,000 on the cruiser and $50,000 on the battle-ship. The Union Iron Works' bids were lower than those of the Newport News Company, and the Bath Iron Company, also lower than the bids of the Cramp Company, if the cost of transportation of material from the East is taken into account. This circumstance goes to show that the Union Iron Works have facilities and skill to compete, and more than compete with Eastern companies, and are safe in respect to merchant ship building for the Coast, also in any case when the material for ships can be laid down here at its price in other markets of the world. There is nothing discouraging in the circumstance in so far as the estimates.

The Risdon Iron Works, of this City, are now experimenting with a down-draught furnace, and the circumstance demands some attention here. Their shop furnaces have been fitted up on what is called the Hawley system, with cross drums at the front and bridge-wall, and a water grate of tubes between. Below these is a Mailer grate, to catch and re-burn any fuel that falls through the water grate. There is no smoke, and the result is, as in all down draught furnaces, much better than feeding fuel on the wrong side of the fire. Among various proposed methods of burning fuel without the nuisance of smoke, and the great losses of combustion, none give much promise of survival except down draught, or conducting the gases from fresh fed fuel through the incandescent portion of the fire. There is only the maintenance of water grates to contend with. All failures, so far as we know, are in this part. Whenever a durable grate is provided down draught will become the rule. The difficulty is in the high temperature by convection, incrustation or obstruction to circulation, and destructive elements in the fuel. The method of constructing the grates in the Hawley system will be explained in a future number.

Water power in the mountains and electric transmission to the plains, is the foremost subject of our time. The "wind work" of these schemes is plentiful, and there are any amount of promoters who are willing to arrange for some one else to furnish money to carry out the undertakings, or which is the same thing, "bond" the works to start with and without paid up stock. This kind of scheming is of but little use except to direct the attention of real business men to the matter, and these will in due time take it up. One such enterprise now being considered is the utilization of the waters of the Santa Ana River, in San Bernardino County, California, from where 8,000 horse power can be distributed to various cities and points within range. One successful example of the kind would bring out many more, and it is to be hoped this case is one of real business instead of "promotion." It is not a wild guess to say that the power of mountain streams in California is to be some time a principal factor in her prosperity.

We managed, last month, to crowd two considerable blunders into one small note respecting an electrical company in Sacramento and the Folsom Water-Power Company. One blunder was the statement that the gas and electrical plants at Sacramento were municipal property, an impression derived from the fact that when we executed some engineering for the city, some years ago, the mayor of the city and chief officer of the gas works was the same person. The other blunder related to the amount of water available by the Folsom Water-Power Company, which Mr. H. F. Livermore, the president of the Company, informs us is never less than 4,000 horse power, even at the driest season, and that the amount to be transmitted to Sacramento will be so inconsiderable a portion of the whole that fluctuations of use there would be unnoticeable. The American river, as Mr. Livermore explains, is peculiarly a snow-fed stream, having a summer maximum flow in June, and above Folsom is one of the most permanent streams in this section of the coast. We expect, at some future time, to publish the principal facts relating to the hydraulic works at Folsom, including data for summer flow, if obtainable.

ELECTRICITY.

NOTES.

Among the possible, if not probable, phenomena of electricity is the transmission of photographs, pictures, or letters. Prof. Jaques, in lecturing before the German Technical Society of Boston, last autumn, described some experiments that convey an idea of necromancy. Writings on a card were photographed, and transmitted from the negative, reproduced in facsimile by an electric current. Of this strange phenomenon not much is known at this time, but should such a means of reproduction be practicable, a letter could be sent thousands of miles in as many seconds.

A corporation in London, called the Lithanode and General Electric Company, are making a specialty of small storage batteries for lighting carriages and omnibuses, for stage purposes in theaters, lanterns, and similar purposes. The plates are made in panels of a substance called "lithanode," also of a combination of this and spongy lead, held by a copper wire grating. It is strange what a number of uses are found for the application of these batteries containing from two to hundreds of cells, the volume being reduced to pocket dimensions for a lamp. There seems to be a wider application of the system there than here at this time, not of inventions but actual use.

The long telephone line between New York and Chicago is unquestionably working through a distance of 950 miles, and the question now arises what are the limitations in respect to distance. The line is composed of two No. 8 copper wires weigh 435 pounds to the mile, or 423 tons in all. The poles are of cedar, 42,750 in number, 45 to a mile. The operation of the line is reported to be such that no fear exists of success with lines of double the length, and there is already talk of such a line from New York to this City. This is not a likely proposition ; people out here have less talking to do in their business, and prefer the more responsible methods now in use, besides the cost in transmission would be prohibition, if on the basis of the Chicago line, which charges $9.00 for five minutes' use.

The Dickson Manufacturing Company, of Scranton, Pa., have contracted to make for the Edison Company, at New York, a quadruple-expansion engine of 2,500 horse power. The cylinders will be 26, 37, 52 and 72 inches diameter, 36 inches stroke, to run at 100 revolutions per minute, with an initial pressure of 210 pounds per inch. The arrangement will be of the marine type, the armature on the engine shaft forming a fly wheel. This will, no doubt, be the first high-speed, quadruple engine of large size made for stationary purposes in this country, and, as a beginning, is an extensive start. If the load was to be variable, as in the case of cable railways, or even electric railways, there would, no doubt, be a loss by the fourth, and possibly by the third, cylinder, the pressures in these falling below the atmosphere under a reduced load or resistance.

At Herstal, in Belgium, a large works have been fitted up with electrical transmission throughout. Two massive dynamos were built around the engine shaft, and the power carried off to sixteen distributing motors in the various departments of 3 to 37 horse power, the aggregate being 500 horse power. This is the most extensive and complete installation of the kind to this time, and was adopted after careful research and calculation respecting the comparative cost of shafts and belts for the same work. The efficiency guaranteed was 70 per cent, but by using large conductors and other provisions for economy it is probable the loss will not exceed 20 per cent., and not more than the common means of transmission would have consumed. This is significant, and if the main distribution of power in factories can be thus arranged it opens up a new field for electric apparatus, in taking the place of "first movers."

MINING.

NOTES.

There is promise of an interesting and perhaps valuable contest between ore concentrators, in Australia. The Parke & Lacy Co., of this City and Sydney, and the Luhrig Company of London, or their agents, Messrs. W. & J. Lempriere of Melbourne, are the principals. From a letter by the Parke & Lacy Company, in the *Australian Mining Standard* of October 29th, they evidently "mean

business." There is to be a forfeit of £1,000, which Mr. Lacy, who is in Australia at this time, proposes to devote to some public purpose, if gained by his firm. The *Standard* thinks the contest should include other machines, besides the Frue and Luhrig types. Judging from a drawing and description of the Luhrig machine, it is in effect a progressive concentrator, with the belt surfaces flat and moving transverse to the course of the pulp. A number of machines have been erected in Germany, and elsewhere on the Continent, it is claimed with remarkable results. One plant in the Laurium mines, in Greece, is to treat 1,200 tons a day of dump waste.

The late report of Captain Josiah Thomas on the Harney Peak tin mines is not encouraging to the shareholders. Captain Thomas is manager of the Dolcoath tin mines in Wales, and was selected as an expert by the English shareholders in the Harney Peak mines to come out to examine and report on their value and prospects. A summing up of his analysis of ores and conclusions amount to the statement that the ore yields about 40 pounds to the English ton of black tin, which contains 73 per cent. of pure tin. This is equal to 1.3 pounds of tin in 100 pounds of ore, and will not pay for working at the Dakota mines, where reduction is necessarily expensive. The report deals with the principal mines in detail and independently, the geological formation, and whatever is likely to bear upon future production, with the result above named. This is unfortunate for all concerned. When tin mines of real value are discovered in this country they will be quietly worked without going abroad to sell the property.

It is not quite clear why the Board of State Examiners have refused to publish the Mineralogical Report for 1891, but is not hard to conjecture. The Board has referred the matter to the Legislature, and in so doing have, no doubt, hit upon the best thing to be done with the report. The "assistants in the field" is a questionable and heterogenous method of collecting data that cannot, in the nature of things, be complete, or nearly complete. We are not questioning the ability or the efficiency of the corps, but the method. No statistics of value will ever be compiled without a distinct law with penalties to enfore an annual or semi-annual report from every mine in the State. Such reports need not include any subject matter that would disclose losses or gains, but just such things as the assistants now collect. These reports, properly attested, would form

a complete showing of this industry, and could be supplemented with expert reports of a technical kind on any special subject that demanded explanation. The business should be done under, and at the control of, a centralized head, as is done in Australia, but not necessarily with such elaboration.

"The mining interests around Plymouth are starting up again. San Francisco parties have taken hold of the Osceola mine, and are ready to let a contract to run a 300-foot tunnel. T. Bawden's claim, south of the Bay State, has been bonded by Dr. Boyson, who intends to sink a shaft and thoroughly prospect the ledge. The first shipment of bullion from the Bay State mine was made on Oct. 25. Three hundred tons of rock, crushed in the Plymouth mill, returned $1,913 in gold, and yielded five tons of sulphurets, which produced $421, making the rock average $7.78 per ton. A contract has been let to Knight & Co., of Sutter Creek, for a hydraulic engine and pump with a capacity of 300,000 gallons in 24 hours. Work on the plant is being pushed ahead as fast as possible, and when complete, sinking and drifting will be inaugurated. During October quicksilver produced at the mines was shipped from Calistoga as follows: Napa Con. mine, 575; Great Western, 500; Mirabel, 384; Sulphur Bank, 125. Total for month, 1,584."—*Amador Ledger.*

THE TECHNICAL SOCIETY.

This Association held their regular monthly meeting on Dec. 2d, at their rooms, 815 Market Street, in this City, the Vice-President, Mr. Luther Wagoner, C. E., presiding.

The following new members were elected:

Wm. F. C. Hasson, Consulting Engineer, San Francisco.
Frank E. Lesourd, Mechanical Engineer, Portland, Oregon.
Albert W. Smith, Professor of Mechanical Engineering, Stanford University, Palo Alto.
Chas. B. Wing, Professor of Civil Engineering, Stanford University, Palo Alto.

Four names were proposed for membership, and referred.

A petition praying for the establishment of a Department of Highways by the General Government was brought before the Society by Mr. Marsden Manson, and was disposed of by a resolution to the effect that road improvement was a proper function of the tates and counties, and that information in respect to road making

should be disseminated through the colleges and universities of the several states.

The subject of a topographical map of California, acted upon previously by the appointment of a committee in April, 1892, came up again for consideration. The report of the committee, signed by Mr. C. E. Grunsky and Hubert Vischer, was accepted and placed on file.

After considerable discussion of the subject the following resolution was adopted :

"That the committee now having charge of this matter from the Technical Society be continued, as a part of the general committee from the other bodies that are mentioned, with authority to recommend a bill embodying the specifications that have been presented and are on file, to the Legislature, covering this matter; that its action carry with it the endorsement of this Society so far as it is recommended in the report, but that it does not carry with it the endorsement of any modifications that any legislative body or committee may make. The Society should be guarded from endorsing a bill which the Legislature modifies after presentation."

In view of a lengthy discussion, which preceded, and the various points and explanations therein involved, there is no doubt but the disposition of the subject, above indicated, was expedient. The use of the Society's name in promoting any matter whatever should extend only to the technical features involved, and while it may sometimes be difficult to mark out a line of division between the technical and executive points in such a case, all doubts should be directed on the conservative side.

In the present case, for example, the Technical Society may, within their proper functions as a technical body, consider and express views as to the nature of a map of California, or even the requirement of such a map, but as a body they should not deal with or attempt to influence legislative, or other action which is to become a question before the people.

This distinction is not easy to make clear, perhaps a better way to state it is, that as a technical body the Society should not deal with matters of opinion, that have two sides, and are indeterminate, but keep within such problems as can be decided by scientific and physical data, problems that can be considered on grounds of truth, and error, not opinions or personal interests.

At the next regular meeting, on Jan. 6th, 1893, new officers will be elected for the ensuing year.

MUNICIPAL GOVERNMENT.

One of the most astonishing pieces of economic literature that has appeared for a long time, is an article by Mr. Joseph Chamberlain, M. P., in the *Forum* for November, on the "Municipal Management of Cities in England and America." There have been, in the quarterlies and higher class serials during five years past, several former articles dealing with and explaining the municipal management of English cities. One relating to Glasgow, and another to Birmingham, but heretofore, so far as we know, no direct comparison with American cities.

Such reading is not comfortable, but medicine is rarely palatable, and it is doubtful if there are other means to induce reforms so effectual as such comparisons. The enormity of the waste and its extent can not be judged in any other manner so well as by comparing cities populated by people of like language, nearly the same customs, and with the same lineage.

Mr. Chamberlain chooses for comparison the cities of Boston and Birmingham, having a population nearly the same, Boston being 448,000 and Birmingham 430,000. Without going into the statistics, which are given in a very elaborate way, Boston spends *six times* as much in municipal outlay as Birmingham, and secures a great deal less for the money.

In respect to salaries we imagine that those paid in Birmingham are quite as much as in Boston, for example, the town clerk has $11,000 a year; the city surveyor, $7,000; the treasurer, $5,250; chief of police, $4,600; health officer, $5,000; engineers of water and gas departments $6,250 each. The salaries of officers in Boston are not given, but are doubtless less.

In Birmingham the city provides baths, wash houses, free libraries, and museums of art, free schools, has ten public parks, with various other institutions that do not exist in the same degree, if at all, in Boston. The suffrage is wider in Birmingham, the register for 1891 containing 88,186 names against 73,000 in Boston. Several workingmen have seats in the council of Birmingham, and are able to attend without interfering with their work.

In official reports it seems that in one hundred representative cities in America, having a population of 12,425,366, the municipal expenditures amount to an average of $16.77 per head, while in Birmingham it is $4.50 a head, but we imagine that an average of one

hundred cities in England would give a still lower amount per head, because in some places there are "no taxes whatever," owing to the profits realized from municipal property, and in some Scottish towns a citizen is actually paid a premium to come and live in them.

Last year the gas department in Aberdeen paid back to the consumers a dividend of 50 per cent. on their bills, the original rate being only 62½ cents per thousand feet. Putting together such facts as appear, and comparing with other cities in Great Britain whose municipal taxes are known to be small, the probability is that in one hundred representative cities the rate will not be more than $2.50 per head, against $16.77 in this country. Referring again to Mr. Chamberlain's article, one principal reason for this we think will be detected in the following extracts:

"All the higher officials are appointed by the Council itself. The minor officials are appointed by the councillors of the several departments, and confirmed by the Council; and the day workmen either by the councillors or more generally by the permanent heads of the department. When a new official has to be elected no questions are asked as to his political opinions, and no interference would afterwards be tolerated with his exercise of electoral privileges. It is an unwritten law that no paid official shall take an active part in political contests. He is expected to refrain from the platform and press in relation to such controversial matters, but his private opinions and his votes are matters exclusively for his own discretion. Once chosen, if he discharges his duties well and faithfully, he remains in office for life, or till his resignation; with the probability that if he is disqualified by age or infirmities he will receive a pension proportioned to his salary and the length of his service."

* * * * * * * *

"These gentlemen, with all the other permanent officials, are expected to give their whole working time to the corporation, and not to engage in any other occupation. Some of them have been more than thirty years in its service. They have grown with its growth, and remained at their posts while the composition of the Council has changed many times, all enjoying the full confidence of their successive employers. To an Englishman the idea that paid municipal office should be the sport of successful politicians is utterly abhorrent. The personal honor, the trustworthiness, and the fidelity to their engagements of the permanent official service — whether in the Departments of State, or in the municipal administrations of the country — are a national possession, and a source of pride and satisfaction to all who are interested in the welfare of our institutions. To substitute for such a class — so distinguished, so faithful, and so absolutely honest and incorruptible — a number of casual occupants of posts for which they have no sufficient qualification — political cadgers and hangers-on, with no real love for their work —

with no ambition to distinguish themselves in it, and only anxious to fill their pockets in the shortest possible time before they give place to a new swarm of the same breed — would be a disastrous revolution, and would, in the opinion of every public man in this country, be the certain precursor of inefficiency, corruption, and extravagance in our national and local administration."

The inefficiency and extravagance in our municipal affairs in this country arises from a number of causes, among which dishonesty has a prominent place in the larger cities, but not in small ones. The method of management, which is much the same thing as the capacity of officers, is, perhaps, the greatest reason, and this again is a result of electing paid councilmen by the political parties, to be turned out in two to four years irrespective of qualification or service rendered.

In the same number of the *Forum* there is an interesting and instructive article from the pen of Charles Francis Adams, on "Municipal Government in Quincy, Mass.," too long to quote from, but pointing in various ways to the conclusion that cities can be politically governed, that is, governed by political parties. The main theme of Mr. Adam's article is, however, compulsory service, which existed in Quincy, and by which means the best citizens can be compelled to serve in municipal offices, or be heavily fined for refusal.

STEAM AND ELECTRICAL ENGINEERING IN CITY BUILDINGS.

[Communicated.]

In large city buildings, for offices, hotels, stores and the like, the steam plant — including boilers, heating and ventilating appliances, engines, pumps, elevator machinery, — is too often a source of unnecessary expense and annoyance. This undesirable condition results quite naturally from the manner in which contracts for the installation of such work are frequently awarded. The contractor, who is asked to bid in competition with others on inadequate specifications, and who carries out his work without the supervision of any compent mechanical engineer, is not by any means wholly to blame for the result. Similar trouble arises in the installation and working of the electric lighting system, and from the same prime cause.

To give an illustration — the writer was consulted as to the reason of the unsatisfactory working of the electric lights in a large

city club. It was annoying to the members to find that after employing a first-class architect, and sparing no expense in the interior finish and decoration, the artistic electroliers could not be made to furnish enough light to enable one to read. The pressure on the street mains was evidently not at fault, as lights in neighboring stores supplied from the same source were sufficiently bright. On examining the specification for the electric lighting work in the clubhouse, the following full directions were found for wiring. "All outlets shall be wired for electric lights of sixteen candle power. Main wires to be brought to northeast corner of basement. All work to be in accordance with insurance rules for wiring." The contract for carrying out this lucid specification was secured by a "practical bell hanger and electrician," who fulfilled it, doubtless to his complete satisfaction.

It is noteworthy that the "practical bell hanger" is always able to underbid the electric light company on a specification of this kind; and, if he is unhampered by the supervision of any cranky engineer, he somehow manages to make a comfortable and honest profit at the same time. This is one of the advantages possessed by the purely "practical man" over the man who thinks it necessary to understand his business.

Owners and architects are not, and should not be, experts in mechanical engineering; and while they may succeed, with the aid of conscientious contractors and insurance inspectors, in producing a steam and electrical plant which will perform its functions without blowing up or burning down the building, such fortunate success is likely to be attained, if at all, only through an unnecessarily large expenditure in first cost and running expense. Intelligent insurance rules, enforced by adequate inspection, can be of great assistance to the architect in obtaining a *safe* steam and electric plant; but they are of no avail in securing economical and efficient machinery, or in determining the proportions and arrangement of apparatus best adapted to the purpose in hand.

Accordingly we find in our otherwise magnificent city buildings, chimneys that will not "draw," and which have to be helped by troublesome and noisy blowers; boilers and engines and pumps which are too large, or too small, for the work they have to do, and consequently not economical in performance; boiler rooms made too low, necessitating wasteful boilers and expensive systems of piping; walls and floors without provision for running electric wires so they may be accessible; insufficient or ill-shaped room for the steam

plant; no convenient place for receiving and storing coal; no consideration of the problem of economically handling fuel and ashes; compound engines for economy where simple ones would be preferable, and *vice versa*; live steam used for heating, while enough exhaust to do the work is constantly thrown away, to fall in an unpleasant spray upon the passers by, and so on — any mechanical engineer can easily extend the list of the sins of his architectural brother indefinitely.

Probably the most universal source of offense in buildings of northern cities is the heating system. The efficient heating of a large building by steam or hot water requires a most thorough knowledge of the principles and practice of steam engineering, applied after a careful study of the special conditions of a case. To find the radiators so distributed that certain rooms are always too hot while others are too cold, with a coil here and there in which no circulation can be obtained, and pipes in which the water keeps up an incessant hammering, is by no means as uncommon as it should be.

The responsibility for these sins, and others of like nature, rest about equally between the owner and the architect. No one can have a greater respect than has the writer for the architect worthy of his profession; which is the more reason for endeavoring to keep him from falling into disrepute by straying out of his proper sphere; for no man has the ability to stand high in architecture and, at the same time, to be thoroughly informed in the theory and practice of modern mechanical engineering; neither can much enlightenment be expected from the contractor, whose judgment is warped by his desire to "sell goods."

The foregoing propositions are so much in the nature of axioms, that it would seem unnecessary to state them in an intelligent community were it not that the conclusion to which they lead is so frequently disregarded. The conclusion is that persons who intend to erect buildings for business, offices, hotels, and the like, should insist that the plans and specifications for the steam and electrical appliances be made under the direction of a competent and disinterested mechanical and electrical engineer. The latter should, of course, consult with the architect to insure proper provision for these features in the building plans, and should also be entrusted with the supervision of the erection of this part of the plant.

"THERMO."

FOUR HUNDRED PER CENT. PROFIT.

A firm here, writing to one of the daily papers, relates a commercial circumstance so reprehensible that were it not exceptional, would go far to destroy confidence in our mercantile houses.

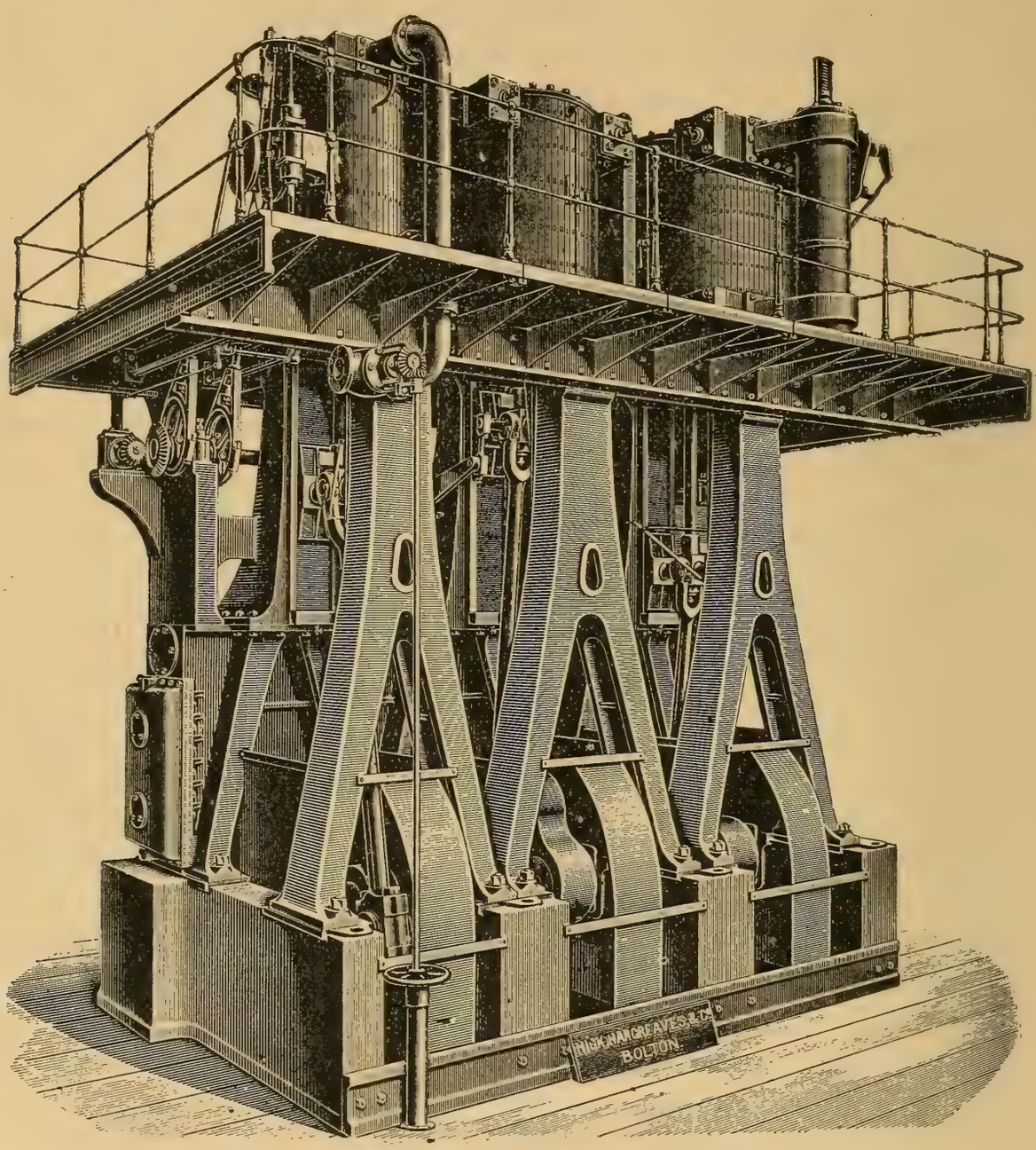
A manufacturer of "straw goods" required certain chemicals for bleaching, which were bought from a wholesale house dealing in that line. The account amounted to $48.95. A duplicate order for the same chemicals was sent to a firm in Boston, Mass., and their account was $9.60, or "one fifth" as much, so the San Francisco firm realized a profit of four hundred per cent. if we allow a "normal" profit to balance freight from the East to this City, which is no doubt enough for sea transportation at least. The railway charges from Boston, on the goods above named, was $13.55 or $3.95 more than the goods were worth at Boston, still there was a saving of $25.80.

This circumstance, which is described in one of the daily newspapers, we make the occasion of saying that swindling of the kind should be an indictable offense, if such a thing is possible without interfering with the "freedom of contract," for the reason that the wrong suffered by the purchaser is a small matter compared to the odium upon other merchants and the effect upon their business. This is especially a wrong for the reason that in most lines of business such methods of dealing are unknown.

The sparsely populated character of this State, the long distances and expense of travel makes it especially important that the small buyer can send here for whatever he wants with the assurance of being fairly dealt with. Such confidence exists, and there are dozens of large firms here that can be named that will take as much care in sending a dollar's worth of goods, as if the invoice covered a thousand times that amount.

Chemicals are a kind of mystery to people. The unknown nature of them coupled with a nomenclature in Latin, furnishes a convenient shield behind which to impose on people, and while one would think that a person buying even $48.95 worth of chemicals would look up a price current, still the chances are they would not do so, but depend on the dealer, as is common in buying industrial supplies in small quantities. The main purpose of noticing this case is to point out that our local industries on this Coast depend in a great measure on mercantile firms keeping supplies of various kinds that

can be drawn upon as wanted. The distance to the original source in the East, or abroad, demands this, and the increment of price to cover this expense of "carrying in stock" is expected, but not 400 per cent.



TRIPLE-EXPANSION ENGINES FOR COTTON MILLS.

We have, a good many times, during four years past pointed out the tendency of land engines toward the marine type, especially in England, and in an early number gave some description of what we believe to be the first large compound engine of the marine type, erected in a cotton mill. This engine was made by Messrs. Hicks,

Hargreave & Co., of Bolton, England, and when we examined it in 1885 had developed a good many requirements for modification, but on the whole had given good results.

The above engraving we have prepared from one of the latest designs by the same firm, to show how nearly the marine type has been followed for "mill engines." There is, in fact, no essential difference in design or construction, except a greater length of connections, and, perhaps, in some unimportant details not apparent in the general design.

WATER WHEELS AT NIAGARA.

The Iron Age of December 8th publishes drawings and a description of the Faesch & Piccard water wheels to be erected at Niagara. The drawings are of much interest, and, we suggest, well worthy of the expense of a technical description, written by some one having knowledge of the subject. The following quotation will show the character of the description referred to :

"These wheels are shown in detail in the figures, the method of connecting the lower wheel with the shaft being clearly brought out. These wheels are re-action wheels, the water being arranged radially over the interior and over the wheel periphery, being guided to the wheel by 36 paddles, arranged as shown in the sectional plan view of the wheel. This drawing also shows the form of the 32 paddles forming the wheel proper. Thanks to this arrangement the pressure of the water on the wheels is completely equalized."

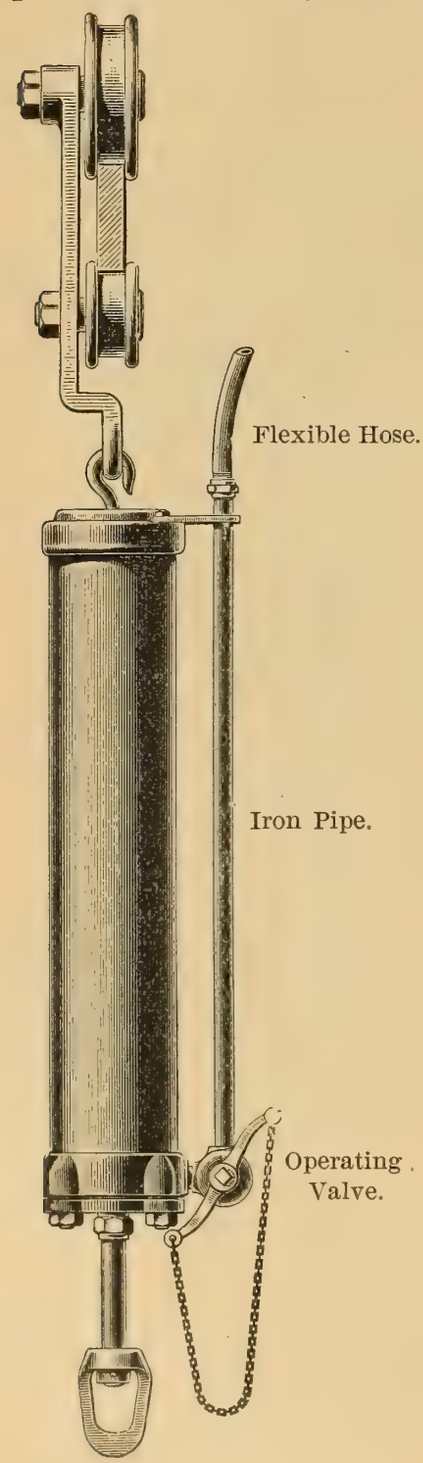
A little further on we are informed that a fly wheel on the wheel shaft "has a speed of 11,000 feet per second at the periphery," which is certainly an extreme, and fifty times more than any other example we know of. The writer wisely kept clear of the regulating mechanism, which is a study, and by no means easy to describe. It is similar in construction to that employed to regulate the water wheels of the Industrial Electric Light Co., at Geneva.

The wheels described above as of the "reaction" kind are nothing of the sort as this term is applied in common use, on the contrary are of the Fourneyron type, with curves corresponding to Girard impulse wheels, and, if we may be so bold as to criticise, are not of high efficiency, but that is, perhaps, not important in the case. There are a number of interesting features in the designs that we reserve for future comment.

A PNEUMATIC HOIST.

MESSRS. PEDRICK & AYER, PHILADELPHIA, PA.

The ingenious implement, shown in the drawing, is a hoist for use in any case where chain pulleys, or other hand-hoisting tackle is employed, with the difference that the present device is operated by power, and at any desired speed, consequently very different.



It is not an uncommon opinion that elastic gases cannot be depended upon as a means of operating hoisting apparatus. This is a mistake even in respect to steam, which is subject to condensation. A good many steam-piston hoists have been made in England, and their action has been found very satisfactory. In the present case the medium of transmission is air, furnished by a small compressor when no general supply is at hand, and the whole outfit is one of exceeding simplicity and cheapness, also one of convenient and accurate movement.

The makers supply these hoists to raise from 500 to 3,500 pounds, at pressures from 60 to 75 pounds per inch, and in average use the area of the compressor piston need not be more than a tenth that of the hoisting piston, or, in other words, one compressor of like diameter will operate a dozen or more of the hoists. One method of mounting and operating is indicated in the drawing, others will suggest themselves.

It is an invention capable of very wide application in connection with machine tools of any kind. In one works, we know of, such a system was introduced throughout, with the result of dispensing with "floor laborers," who were only in the way, after the lifting tackle was in place.

THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.

There has been organized at the East a very important association, called the Society of Naval Architects and Marine Engineers, whose object will be to promote the art of ship-building in all its branches, both commercial and naval. The committee of organization consisting of Wm. H. Webb, of New York; Lewis Nixon, general manager of Cramp's Ship-building Company, of Philadelphia; Col. E. A. Stevens, of Hoboken; Francis T. Bowles, Naval Constructor U. S. N.; and (ex-officio) Clement A. Griscom, President of the International Navigation Company, expect to incorporate the society in New York, and are now sending out invitations to membership, hoping to have the first meeting at the time of the naval review.

The list of those who have accepted positions in the preliminary organization includes many well-known names from all sections of the country. President, Clement A. Griscom; Vice President, T. D. Wilson, Chief Constructor of the Navy; Charles H. Cramp, president of Wm. Cramp & Sons' Ship-building Company; Geo. W. Melville, Engineer in Chief, U. S. N.; Geo. W. Quintard, New York; Irving M. Scott, President Union Iron Works, San Francisco; Gen. Francis A. Walker, Boston; W. H. Webb, New York. The members of the council include H. T. Gause, Wilmington, Del.; F. W. Wheeler, West Bay City, Mich.; W. H. Jacques; Gen. T. W. Hyde, Bath, Me.; J. W. Miller, New York; C. H. Orcutt, President Newport News Ship-building Company; Nat. G. Herreschoff; J. F. Parkhurst, Cleveland Ohio; Naval Constructors Hichborn and Fernald of the Navy; Charles H. Loring (ex-engineer in chief), and Commanders Chadwick and Sampson, of the Navy; Harrington Putnam, of New York; Assistant Naval Constructor W. L. Capps, being Secretary and Treasurer.

In consideration of the increasing importance of our ship-building interests and the development of the Navy, the organization of this society upon a basis similar to that of civil engineers and kindred professions, is regarded as opportune and having a valuable and extended field of influence in technical subjects and public affairs.

THE EGAN COMPANY'S CATALOGUE.

We received, some time last month, a copy of a recently issued descriptive catalogue by the above-named company, that deserves more than ordinary notice. First, among a number of features that will elicit surprise, are the engravings. This country has become justly celebrated for the excellence of the wood engravings employed in advertising literature. This reputation is not new and is outrun by the fact, because the improvement of the last five years has far exceeded that of any like period before. The present collection of more than three hundred plates of high and uniform excellence we believe has never been equaled in any other country, and aside from their value in clearly explaining the machinery, constitute a wonderful collection in an artistic way.

The whole work, 270 pages, quarto size, with numerous folding plates, was executed in Cincinnati, and gives proof of an excellence in typographical art there, that is highly creditable to that city. We have compared it with a large number of similar works of the kind on file here, and must concede that, even divested, as it is, of all embellishment, there is no other to compare with it.

In respect to the subject matter, its compilation and dress is a credit to the Company, written almost in the impersonal pronoun, and confined to careful explanation of the machines and their functions. We cannot too much commend this plainness and excellence that appeals especially to the higher class of engineering and constructive skill of our time, and is consonant, no doubt with the character of the implements here represented and described. The resources that have permitted the production of such a catalogue should be a matter of pride to those who are interested in American skilled industry.

A technical notice of the machines illustrated is out of the question, within limits attainable here, is perhaps not called for in this connection, the object being to speak of the character and "make up" of the "catalogue." It has one fault, or rather one misfortune, its extent and cost must limit the edition and the number of people that can profit by its use.

NOTES ON NEW AND PATENTED INVENTIONS.*

BY J. RICHARDS, IN CASSIER'S MAGAZINE.

No. I.

INTRODUCTORY.

It is proposed in the articles that will follow, to review various inventions, especially those of a mechanical nature, and such as seem to have a general interest or mark an advance in the arts to which they pertain.

It is not pretended that the selection made will be complete, or that opinions expressed concerning them will be infallible. The most consummate and versatile knowledge of the industrial arts would not warrant such a pretentious claim, but an effort will be made to be impartial and to speak without prejudice, fear, or partiality. Any error made in understanding the nature, scope and purpose of a new invention will be cheerfully corrected by a supplementary notice, when explanation is made and fair grounds presented for such correction.

It was at first intended to include in these notices the patents of several foreign countries, but the observations of several years have confirmed the fact that there are but very few inventions, especially those of a mechanical kind, produced abroad, that are not also patented in the United States and in England, if not by the same inventor, then represented by similar ideas or cases, so the plan of including Continental patents has been abandoned, except in a few cases.

In the great struggle after new methods, processes and implements that characterizes our day, and which is a principal factor in our material progress, there is a constant rule of the "survival of the fittest." Opposed to this is the claim, sometimes put forward, that the value of a patented invention is not so much in its intrinsic worth as in the method of presenting and introducing it to the world or to a market. Both propositions are in a sense true, but with this qualification, that "permanent" success always depends upon intrinsic worth, and while a short success may be attained by a

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plausible but faulty invention, the future is sure to relegate it to the place it belongs. It is perhaps unnecessary to argue this. Everyone's observation will prove it.

Another feature of new inventions that may be mentioned here and one that will be watched in these notes as closely possible, is cases where constructive and operative conditions violate the settled rules of common practice, or sanctioned practice. To illustrate what is meant, conical shells for machine bearings, ball bearings for other than special purposes, radial running faces as in rotary engines and pumps, and many other things of the kind, condemned alike by theory and experience are often elements of new inventions.

The inventor of a new process or implement, unless himself a good mechanic and constructor of such things, ignores all but the "functions" of what he attempts to improve. The conditions of construction and use, also, more frequently, economic conditions are overlooked. An inventor is very apt to forget that whatever is performed or attained by a new invention, to be a success, must produce an old result at less cost, or a better result at the same cost. This is an inexorable rule, without which "survival" cannot be expected.

Another thing that will be considered here, is the important matter of "added detail." This might properly come under the head of "operative conditions," before mentioned, because it involves maintenance and attendance, but may be made more plain by quoting a remark once made in England, by an experienced designer and constructor of machinery. He said: "The great art of designing machinery consists in leaving out parts and pieces."

These preliminary remarks are not intended for instruction or suggestion, but to indicate the methods that will be pursued in speaking of the merits of new inventions and what is said of them.

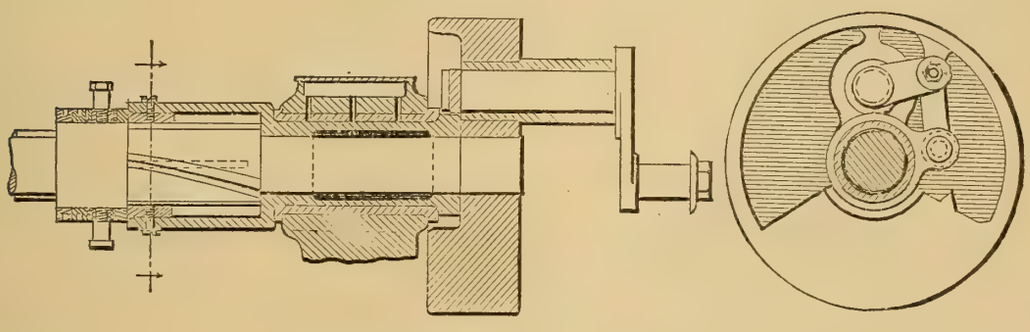
U. S. Patent, No. 473,906, May 3, 1892.

Bullock—Steam Engines.

This patent seems to be a complement to a number of improvements in tube drilling apparatus, patented at the same time by the inventor. The present patent relates to reversing gearing for steam engines, and is an adaptation of a method much employed on small steamers in Sweden. The Swedish gear, which is more simple, consists of two sleeves on the main shaft, an outer and an inner one, both loose, the inner one sliding through

the outer one. The outer sleeve to which the eccentric is attached has no movement endwise, but is driven by the inner one, which moves on a spiral key or feather in the shaft, so that both sleeves revolve together in respect to the shaft, the inner one, when drawn out or in, moving the eccentric to the angle of advance each way, for running right and left. In the Swedish method the inner sleeve projects beyond the outer one, the extension being formed into a toothed rack by cutting grooves around it, into which a pinion meshes. This pinion is on a vertical shaft, and is operated by the pilot or *styrman*. Even on steamers of some size, the engines are reversed by the pilot from the "roof."

In the present case there is the same sleeve moving endwise on a spiral key or feather, by means of a fork and collar, but the sleeve passes through the main bearing, as shown in the drawing, and is



connected to a stem extending through the crank pin to an overhung crank or eccentric. The arrangement is ingenious, also is elaborate. It is evidently to meet peculiar conditions of use or application, and will require good fitting.

Of the various methods of reversing the rotary motion of steam engines those that are most elaborate have succeeded best; not because of elaboration, but because the eccentrics can be fixed on the crank shaft and a greater stability of working parts secured. The most common method is the link, which for a long time held almost complete sway, down to ten years ago, when there came up various ingenious modifications of radial gearing, such as Joy's and Marshal's, that at first gave promise of improved functions, but the link movement is hard to displace.

Besides the Swedish reversing gearing before described, there comes to mind another case where a special method has for some reason proved the "fittest," the loose eccentric employed by Penn of London, and others for small paddle steamers with oscillating engines of the overhead-hitch type. The handling of these engines

which can be seen on the Thames' "penny boats" around London, seems to be a marvel of convenience. No miss ever occurs, indeed cannot without serious accident. The eccentrics are balanced loose on the shaft, and so free that a light pressure on the cam rod will throw the eccentric either way to the angle of advance.

There is one example on Puget Sound, where a large portage steamer is operated in this manner with loose eccentrics, and such gearing was once tried at San Francisco, but proved a failure because of "sticking" and permitting the boat to ram the wharves.

The advantages, in the present case, of this peculiar method of reversing lie, no doubt, in its adaptation to engines to operate diamond drilling apparatus, of which Mr. Bullock's company are extensive makers, and in the very condensed form of the mechanism, and the fewness of the parts involved. These considerations, and others of the kind, frequently form a special measure of the merits of new inventions that render general criticism inapplicable.

U. S. Patent No. 478,875, July 12, 1892.

Macdonald, Williams and Hitzeroth.—Rope Driving.

The use of wound ropes for driving the first movers in mills and factories, has become well known, and after five or six years of successful application, has achieved a permanent place among transmitting gearing.

It consists, as shown in the drawing, in winding a common rope around the driving and driven drums, and is arranged in two ways known as double and single wind. In the single wind the rope passes successively around the two drums, each groove being occupied, then the rope is trained back to the point of beginning, and passed around an idle tension pulley set diagonal to the main drums. In the double wind the rope is first placed in alternate grooves across the face of the drums, and then, after passing around an idle pulley, comes back to the beginning, and is wound again over the same course in the manner shown in the drawing.

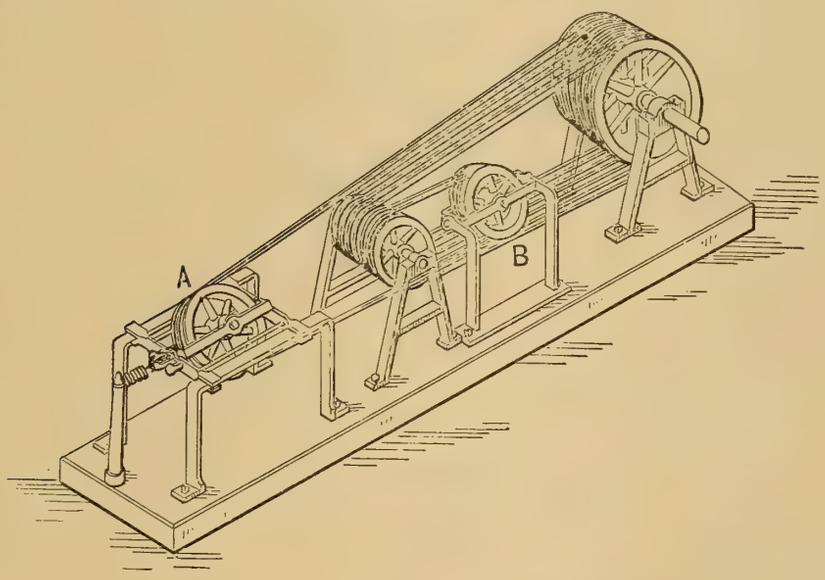
In this double wound system it was found that the ropes had to be "crossed" at some point, usually between the two idle pulleys *A* and *B*, and for a long time this was understood to be an unavoidable feature of the double rope wind. Mr. Dodge, the orginal inventor and introducer of this kind of gearing, when informed that the

ropes could be wound without crossing, said it was impossible, and the problem is introduced here partially with a view of furnishing the skilled readers of the Magazine with a puzzle problem involving some geometry not laid down in the books.

The inventors say, in the patent named :

"Our invention consists in the construction of the main driving "drums, or the driving and driven ones, with an odd instead of an "even number of grooves, so the strands of the rope when double "wound will also be uneven in number, and not crossed between any "two drums, or in any part of the system."

This declaration, at the beginning of the specification, embraces the whole gist of the invention. When the grooves or wraps are of an even number, 6, 8, 10, and so on, the ropes must be crossed in some part of the system, but when the wraps are uneven, 7, 9, 11, 13 and so on, there is no cross of the strands. It seems a queer problem, and was so regarded at the Patent Office, where a model like the present drawing was supplied for experiment. This, we imagine, was of not much practical value, because if the rope is once removed, no one but an expert can put it on again. It seems a



simple matter, but is not, as we can bear testimony from futile attempts of the kind with the same model.

The inventors and their attorney could not well furnish a geometrical analysis of the problem, and as their claim of the crossed ropes in the Dodge system had to rest on facts and examples not existent in the Patent Office, the case became one of some celebrity there ; and it was only after a visit to Washington of Mr. Hoadley, a noted expert in this rope-driving gearing, who went to explain the

method, that the Examiner would risk an allowance of the inventors' claims.

Constructor A. W. Stahl, U. S. N., author of a well-known treatise on wire-rope gearing, whose attention was called to this problem, has promised an analysis of the matter, which if received will be introduced in these articles in a future place, unless anticipated by some one else furnishing a solution in the interval.

It should have been remarked, in respect to the model before mentioned, that the rope could be wound with either even or uneven wraps, resulting in the crossed or open strands accordingly, and had it not been for the difficulty of winding the rope or cord in either manner, the patent officers would, no doubt, have seen their way to definite action at the beginning. It is one of those curious things that crop out, as in this case, by accident, and of which the analysis is difficult even after the fact is fully demonstrated.

Transmission from first movers is an old and long debated problem. The best gearing is unquestionably tooth wheels, but such an assumption must include a kind of wheels that are commercially, if not mechanically impossible. In England where the making of such gearing has been more perfected than anywhere else, there has been attained all that can be expected. The change wheels, or indeed all wheels on high-class machine tools, are cast, and bevel gearing is made so perfectly that it is a common thing for works on the Continent to send to England for wheels that will run without noise, but even with this skill there is a good deal of main driving done with ropes, not on the "wound" method, just described, but on the multiple system. In this country belts, or "bands," which is a better name, are most common, but some examples of tooth gearing have been made that have never been excelled.

One of these was in the Continental Hotel, in Philadelphia, made by Messrs. Bement and Dougherty of that city, for operating the hotel elevator. The cage was driven by a screw nine inches diameter, connected at the bottom by a pair of bevel wheels about 20 and 60 inches in diameter, having a 6-inch face. These wheels being in the well-way of the elevator, communicating with all the halls, the least sound could be heard all over the building, so the gearing had to be noiseless. The wheels were made on a kind of banter. Mr. Bement was one of the shareholders, and director in the hotel company, and when he proposed, in the board, to employ bevel wheels for the elevator, other directors, some of them noted mechanics, objected to tooth wheels on account of the noise. "My wheels

do not make noise," said Mr. Bement, and in this case they did not.

After being "machined," as our English friends would say, the wheels were "ground together." The pinion was in two parts, or rather there were two pinions so fitted together as to be slipped and expanded. The wheels were set up in the works and started, the teeth fitting close and of an odd number, so they changed relatively one tooth at each revolution. Emery and oil were put on the teeth, and the grinding went on for days. Whenever the teeth became loose the pinion was expanded or slipped to produce a hard mesh, and the grinding proceeded. Mr. Bement's instructions were that whenever each tooth would cut a hole through tissue paper placed between the wheels the grinding could be stopped. This was attained, and we suspect that these were the only pair of wheels of the size ever made that ran entirely noiseless, produced by means that are not likely to be repeated.

The other case alluded to was the first movers from the great Corliss engine that drove the shafting in the Centennial Exposition, at Philadelphia in 1876, and now in use at the Pullman Works, near Chicago. As remembered, these wheels were 5 feet and 30 feet in diameter, 24 inches face, engine cut, and ran without any noise but a dull rumble, perceptible only when standing very near to them. Such gearing is very expensive, liable to accident unless carefully guarded, and perhaps no better than the plain Manila ropes employed in the manner shown in the drawing, that costs not more than one fourth as much as tooth gearing.

U. S. Patent No. 474,286, May 3, 1892.

R. Brewster.—Bearings for Machinery.

This invention, which can be best explained in the terms of the inventor, may be one of much importance if it has in any great degree, or even moderate degree, the advantages claimed. Its nature is best explained in the following quotation from the patent specification.

"The material I employ is composed of the following ingredients preferably in about the proportions stated : feldspar, fifty parts ; rock-crystal, fifty parts ; china clay, thirty parts, and flux (preferably borax) thirty parts. These materials are well ground, and combined with water in the usual manner of working pottery bodies or mate-

rials, and they are made by the ordinary processes into a comparatively dry clay or body, or into what is known in the pottery trade as 'slip.' The material thus prepared is, when in the state of comparatively dry clay or body, molded into the required shapes by means of dies and pressure, or it may be first thrown and then turned into form, or when in the form of slip it is molded into the shape required by pouring the same into molds, as is well understood in the pottery trade. Steps and bearings formed of the above material are dried and fired, after which the bearing-surfaces, if not sufficiently true, will be turned, bored, or ground to the required form, and then polished if required, or as may be necessary. Steps or bearings of the character herein described will be held in metallic or other suitable supports or carriers."

Boring, cutting and polishing substance, of granular and, as we suppose, sillicious nature, is unusual at least, and there is also the question of crushing strain.

Various kinds of material for bearings are being invented in rapid succession. One recently exhibited, and the subject of a paper read before the British Association at their last meeting, and experimented upon with favorable results by Professor Unwin, gives some promise of success. The material is called carboid, and is composed of pulverized carbon and steatite.

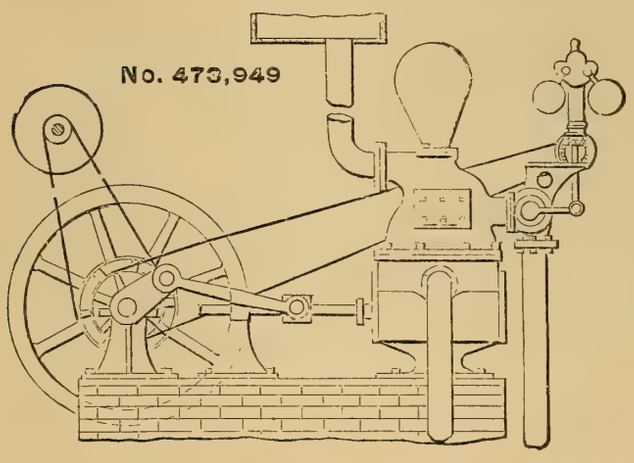
It is extremely probable some substance may be invented to replace metals for the greater portion of machine bearings, but not so probable that such bearings can be made to operate successfully without lubrication where there is considerable pressure. It is, however, a more promising field for invention just now than a good many others that can be named.

The graphite bearings, made at Philadelphia, and the subject of an honorable award by the Franklin Institute, are, perhaps, the nearest approach ever made to practical machine bearings not requiring lubrication. The use of the material has not, at this time, been wide enough to determine the chances of survival, and in this remark use must also mean misuse, because that is often a greater impediment than the properties of the thing dealt with.

Aside from dry bearings, which have not yet achieved a place of much importance, the principal impediment seems to be that nothing but metals will resist the solvent action of oils, and to undertake the introduction of any new lubricant would be the labor of a lifetime.

U. S. Patent No. 473,949, May 3, 1892.

J. H. McGowan.—Pump Regulation.



This patent relates to a modification of pumping apparatus, in which an escape, or relief valve, operated by a centrifugal governor *G*, is placed on the discharge chamber, or in connection with it, so arranged that when the pump is started the water is merely circulated until the pump attains its normal speed, when the escape valve will close, and the discharge against the working head will begin.

This, of course, takes place gradually as the relief or escape valve closes, so the load or resistance to the pump is assumed gradually as the speed increases. The main valve chamber of the pump is divided horizontally by a diaphragm, and there are two sets of discharge valves, so that when the pump is at rest, or running at less than its normal speed, the upper set of valves act as a check against the return of water by the discharge pipe *m*. The other or lower set of valves being then in connection with the valve *n*, and return pipe *k*.

This arrangement is certainly one of value where a pump requires frequent stopping and starting, especially when working against a high head or pressure, or when driven by an electric motor. The added attachments are inexpensive and simple, even when a centrifugal governor is included. The same result could, of course, be attained in a less perfect manner by a pass-over valve on the discharge pipe to be operated by hand. This the inventor describes in his specification.

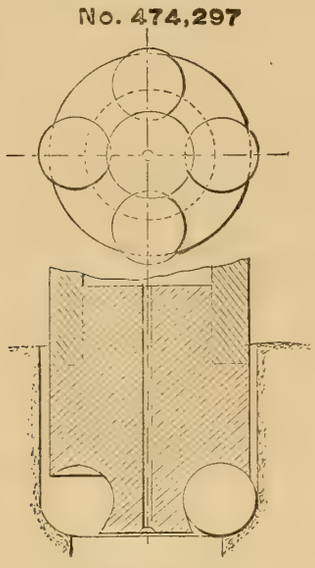
The invention might be described as an automatic pass-over valve, or apparatus, as distinguished from one operated by hand,

with also the difference of providing a check in the pump itself. The functions differ in respect to the present apparatus being a regulator to determine speed below a point where the escape or pass-over valve is closed, or so long as it is in any degree open. The scheme is new in so far as any references at hand will show, and certainly is one of much merit in many cases where, as before said, a pump has to be frequently started against a considerable head. It would operate well in the case of centrifugal pumps working under pressure such as is common in the irrigating wells of California.

The invention also serves to remind us of how much may yet be learned respecting the movements of fluids, and that pumping is by no means the completed art that is commonly supposed.

U. S. Patent No. 474,297, May 3, 1892.

Carl Hoffman, Prussia, Germany.—Rock Drilling.



It has been a good many times pointed out that the hardest substances could be pulverized by rolling abrasion, and that, beyond a certain limit of pressure, a roller bearing was not only impracticable but the best means possible of abrading or wearing away the surfaces in contact; also that this method is extensively applied in cutting hard material, such as glass and granite.

By examining the drawing above our readers will conclude it is a roller-bearing foot step for a vertical shaft, but on the contrary it is a drill for boring in rock. The drawing is one figure from the patent of Mr. Hoffman, who, instead of avoiding friction, proposes to create abrasive action of a very pronounced kind.

The darker-shaded plug in the end of the core barrel is magnetized metal, employed to prevent the balls from falling out when the auger is lifted, otherwise the whole drawing is plain, and the scheme is by no means a chimerical one. Under heavy pressure, and when the detritus can escape as fast as loosened, the abrading action of the balls would be rapid, and the bore of the hole smooth and uniform. It is not likely, but is possible, that under certain conditions such an implement would make as much progress as diamonds when no core is removed.

We are not, however, discussing the merits of the invention so much as explaining rolling abrasion and the limitations of roller bearings, as exemplified in this case. The subject of rolling abrasion is a wide one, and, in the present state of the arts, a novel one, having no application of importance except under the Tilghman system, which will come up in a future place in these notes.

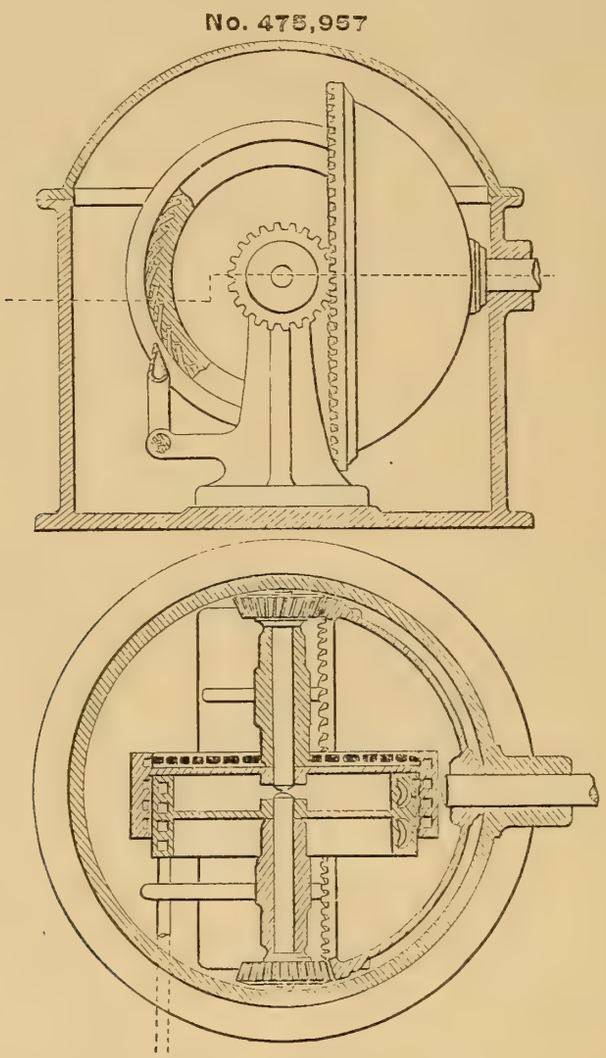
U. S. Patent No. 475,957, May 31, 1892.

G. J. Altham.—Steam Turbines.

The steam turbine, or impulse engine, is, no doubt, in future to have a place among operative machines of wide use. It is only four years since the Parson's engine was presented commercially as a manufacture, and comprehended in its thermal or dynamic aspects all that we can hope to learn of steam impulse as a means of power, but then, like common steam engines, the method is destined to go through a period of mechanical evolution, and, no doubt, a wide one, before it assumes what we call a standard type. Such a result is to be predicted, because the point where successive expansions must give way in favor of simplicity, and the avoidance of detail must be ascertained by experiment, and also by commercial considerations that are still slower in declaring themselves. Mr. Parsons continued to reduce the number of expansions, which means also the number of wheels, in his construction, until only a third of the original number remained.

The Dow engine, invented in this country, which has but one wheel, and provides for expansions and reversal of the current by proceeding progressively from the center toward the periphery of the wheels, and has thus hit upon a base principle, so to call it, that will, no doubt, be a characteristic of the final wheel, whatever other feature it may have differing from practice at this time.

Then, too, we must have the marvelous inventor who produces a horse power with half the fuel and half the steam, perhaps the inventor who uses the steam over and over again, and the one who by gearing "doubles the power." All these, and more, must come before we have steam impulse wheels in any settled form. Still we have, at this day, the guidance of scientific men who will supply the physical data attending on the use of attenuated or nearly impon-



derable fluids, and the required functions of mechanical apparatus to best utilize their expansive impulse force.

Referring now to the motor or engine of Mr. Altham, shown in the two sectional views Figures 1 and 2, it will be seen that the wheel consists of two parts revolving in opposite directions at an equal axial rate, both gearing into one bevel wheel at its opposite sides. The steam ducts are curved and reversed in each wheel, passing from one to the other alternately, but retaining its original volume. In this latter respect the inventor ignores what both the

Parsons and Dow engines employ as a leading feature, the expansion of volume and the area of ducts.

There is also the feature of the "steam joints" or fits between the moving parts, being in the plane of the axis the same as in the Dow engine, and differing from Parsons in which the running joints are radial. There is probability that there will be more difficulty in maintaining close joints in the Dow and Altham methods, and on these, no doubt, must depend, to a great extent, the efficiency of such engines, because with a fluid so mobile as steam, almost without viscosity, the smallest aperture will permit serious leaking.

It is, perhaps, too soon to predict, or write upon, the possibilities and limitations of steam impulse engines, but, as Professor Tyndal once said of another matter, "there is hope and promise" of a wide and important field for them, and conceding the economy of results credibly claimed in late experiments, we are far beyond the point of scoffing at this novel invention, resuscitated from the Hero engine of the Greek age.

We have, as a beginning of this *renaissance* of impulse engines, the warrant of high skill and consummate knowledge of the physical and thermal laws involved in the labors of the Hon. C. A. Parsons, who has very carefully and persistently been experimenting and constructing impulse engines for five years past, and has so far succeeded as to found a permanent manufacture, and to supply electric generators, thus driven, for a number of steamers, among them one or more of the Inman and International line, between New York and Liverpool.

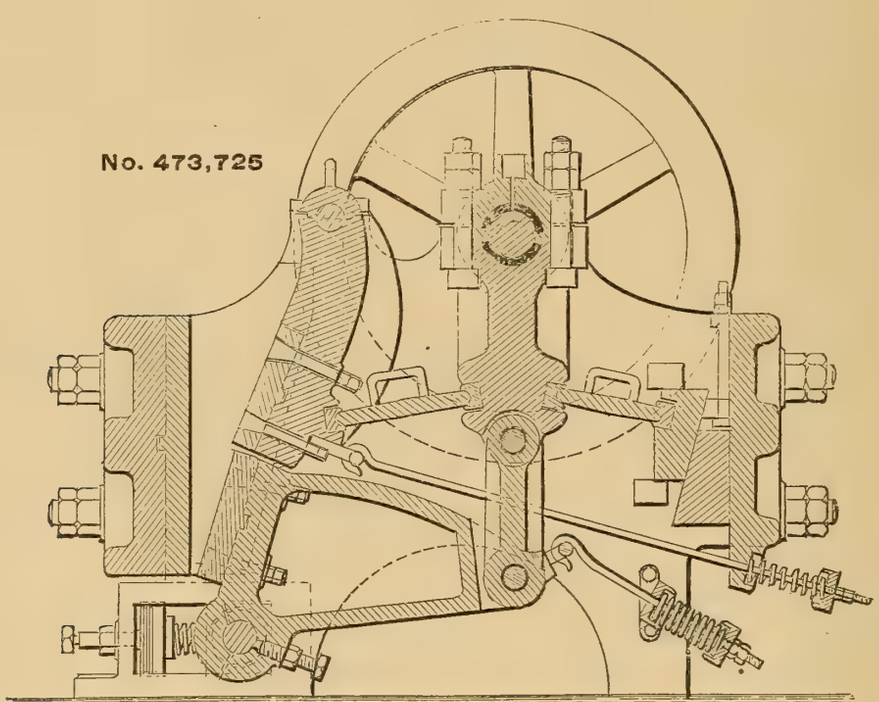
De Laval, in Sweden, too, has brought these motors to a point of economy and success that is commanding much attention in that country among a class of engineers that are careful as well as critical. Herre de Laval has the advantage of a suitable and unique application to his centrifugal cream separators, one of the few applications requiring a speed such as the velocity of steam jets must involve. Assuming the velocity of issue to be 48,000 feet per minute, for pressures of 80 to 100 pounds per inch, and the velocity of the wheels to be one half this much, it calls for a speed of 8,000 revolutions per minute for wheels 12 inches diameter, which does not, however, exceed the tensile strength of the best material, and does not go beyond where very careful bearings can be maintained under light pressure. Structural difficulties must, however, for a long time remain an impediment to engines driven in this manner.

U. S. Patent No. 473,725, April 26, 1892.

E. H. Booth.—Stone or Ore Crushing Machine.

This invention, by Mr. Edgar Booth, of San Franciso, is the first considerable departure for a long time in the class of machines to which it belongs, introducing, as it does, something in the way of functions, and a great deal in what may be called the operating conditions.

The machines belong to the reciprocating-jaw kind, and are dual in so far as the jaws, but single in all other respects, and for the extent of change from common practice have but few added parts.



The following from Mr. Booth's patent specification sets forth in a brief manner the nature of his invention :

* * * "My invention is to attain nearly-continuous action of the machine by reason of the alternating motion of the two jaws, and thus avoid in a great degree the strains such machines are subjected to when their work is done during one half only of each revolution of the driving shaft, also the unequal wear on the principal working parts caused thereby, and thus the strains in my improved machines for a given work being approximately only one half as much at any instant of time as when such machines are single-acting, or have only one reciprocating jaw."

As will be seen in the drawing there are two separate jaws, actuated by the same mechanism, the material to be crushed being

acted on by the jaws successively, both being adjustable so the work may, as nearly as possible, be divided between the two jaws and also between the half revolutions of the eccentric shaft. In this manner the weight of the fly wheels can be reduced to one half as much, so also various other proportions required in machines that act only once to each revolution of the main shaft.

Reciprocating crushing machines seem anomalous in their capacity. At first thought one would suppose that Cornish rollers would crush stone or ore at a rate as rapid as their circumferential velocity exceeds the movement of the jaws of a reciprocating machine, or as the sum of the movement in the two cases. This is indeed a common opinion in the matter, but is far from correct in theory as it is in results. The relative crushing or working movement in the two cases is vastly in favor of the rollers if we consider only the peripheral velocity, but the "working" faces of the rollers, and the only portion of their surface producing any effect, is from their center up to a point where the material will slide back. This is only a narrow strip of the face, not more than an eighth of the perimeter, and even this must be computed by its angular approach instead of circumferential movement, in other words, the effective movement is in the approach of the faces of the rollers toward each other. For this reason we find that reciprocating machines are most common and successful, although, of late years a good deal has been gained in rotary-crushing machine by internal rolling, it may be called. That is by means of a roller or "muller" set eccentrically within a shell or cylinder. The Gates crushing machine is an example of this class.

U. S. Patent No. 475,296, May 4, 1892.

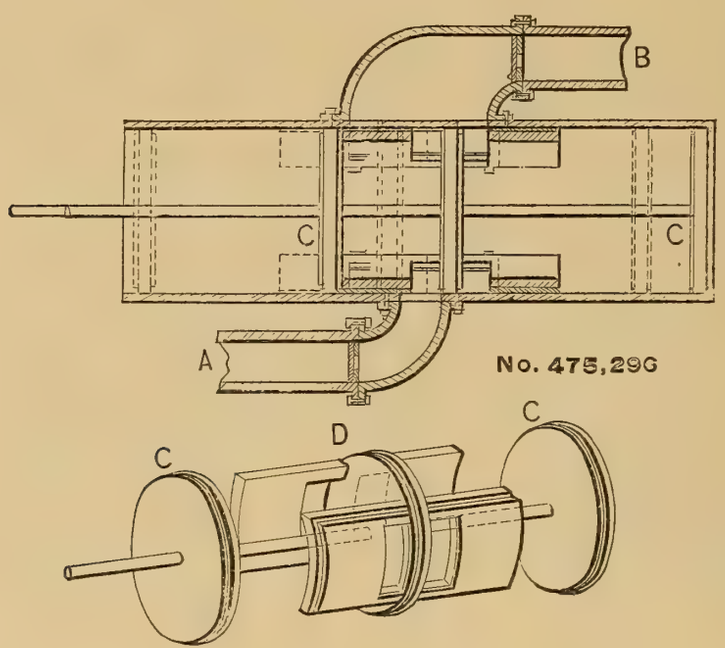
Chamberlain.— Pumps.

This invention is an ingenious modification of pumping apparatus, worthy of study, if for nothing else, to show the possibilities, or want of limitation, in hydraulic apparatus. The student in mechanics and physics sets out usually with an impression that the movement of fluids, and their reactions, is but a simple branch among many others, and that a few theorems cover the field, but as he goes on he meets a world of mechanical contrivances and endless phenomena that will cause despair.

Mr. James R. Maxwell, of Cincinnati, Ohio, one of our most eminent hydraulic engineers, who, after vain attemps to deal with

electrical science twenty-five years before its time, went into hydraulics, as we would say, with an impression that he would, in the future have something tangible and easy to deal with.

It was about the time that Mr. George Shields, of Cincinnati, Ohio, had constructed the great Cornish bull pumping engine, in the water works there, the largest example in this country at the time. This engine caused much trouble. The steam valves persistently refused to perform their functions when moved by tappets, and Mr. Shields had to add an auxiliary steam cylinder to move them. The pump valves showed strong desire to "knock their brains out," as Mr. Maxwell called it. The rising mains and air vessels would split open in a mysterious way, and there was a disposition to chaos all around.



Mr. Shields died during the difficulty, and Mr. Maxwell was called in as consulting engineer to the water works. Then began a kind of evolution. The new business that was to have gone on in quietness and comfort took on a garb of complexity that exceeded even electric phenomena. Mr. Maxwell, after some very hard study, proceeded to put in double-beat valves, each about the size of a driving bell; overhauled, reconstructed, and finally set the great "bull" engine at work, so it has gone on in an orderly way for twenty years or more.

This divergence is to say that among the arts that perplex and bother mankind hydraulics has a first place. The ram of Montgolfier, for one example, has been a sad destroyer of human conceit. It operates when not expected to, and refuses when every condition

is supposed to be favorable. Its "regurgitation" is a mystery, or at least has never been analyzed in a rational way. Efficiency is a mythical quantity, and to "cap all" Mr. Pearsall, of London, some years ago, eliminated the "ram" element from these machines, closing the valves gradually, without shock, and altogether independent of the driving water.

We might go on to mention "water ram," the abnormal diagrams found in Riedler's *Indicateur Versuche aus Pumpen*, and indeed in all pumps; the problem of forces in turbine water wheels, with much more, but it is unnecessary. Any one attempting to deal with the movement of fluids as it occurs in the practical arts will find themselves confronted at every turn with the unexpected.

Returning to Mr. Chamberlain's pump, it deserves at least the distinction of divergence from practice. Fig. 1 is a longitudinal section, and Fig. 2 a perspective view of the moving parts. The pump barrel is open at each end with a discharge pipe *A* at the bottom, and an inlet pipe *B* at the top, situated in the middle of the cylinder, or between the working pistons *C C*. Between these pistons, and sliding freely on the piston rod, is another piston or diaphragm *D*, having extending plates at each side to overlap, cover and uncover, the ports around the central part of the cylinder, and connecting with the pipes *A* and *B*. This is sufficient explanation from which to work out the problem of operation. At least is so for anyone acquainted with pumps. The system, as shown here, is for double action, but it is applicable to the single-acting kind as well.

As most of this chapter is digression, another one will be made to point out an "anomala." The student in hydraulics is taught to compute the discharge of single-acting pumps either by set rules, such as "divide the square of the diameter by 25, and multiply by feet of stroke one way, or by computing displacement and multiplying revolutions or half strokes." This seems simple enough, and is theoretically true, but is not truth, nor near the truth, unless the length and diameter of suction and discharge pipes are taken into account, and also the rate of movement. Under certain conditions, and these very common ones, the water if measured will show quantity far beyond the computed result, because the flow will be continuous, or nearly so, the pump piston acting as an "accelerating" agent to maintain the flow, the same as the oars of a boatman act in respect to a boat's movement through the water.

U. S. Patent No. 477,921, June 28, 1891.

J. M. Anderson — Engine.

This invention has for its object, where triple engines are employed at sea, the conversion of the low pressure or large cylinder to a water pump to be driven by the other two cylinders, so as to employ the propelling power to clear a ship of water in case of such requirement.

To do this the large cylinder is provided with a set of water valves, for single action, one leg of the main frame being converted to a suction pipe with a bilge inlet to the main frame beneath where the leg is bolted down. No drawings are required to explain the invention, which if it has any practical value, could be carried out in various ways. It seems, however, to be a mere "idea," and to have no value compared with the employment of an ejector apparatus fed from the boilers direct.

The question of efficiency does not play much of a part in such emergencies as demand added pumping capacity, besides apparatus of the kind for pumping salt bilge water could not be relied upon when used only at long and uncertain intervals.

The main purpose of mentioning this invention is to suggest that, in all such cases, the fascination of an "idea" must be guarded against, and the invention, whatever it is, should be set up as an equation or an account, with all objections on one side and all advantages on the other side. If this is done, and the footings compared, the chances of survival will appear. It, of course, requires consumate knowledge of an art, and all that is corelative thereto, in order to arrive at the various quantites to be entered in such an account, but the fact is that useful inventions generally emanate from people with such qualifications.

British Patent, No. 10,923 — 1891.

Tyler and de Vesian.—Drilling Square Holes.

This is at least the second patent granted in England for machines to "drill square holes" in metal, and a company has been formed to operate with the invention described in the first patent. The idea, to so call it, is novel, and the machines are ingenious, but one is puzzled to know what square holes are for in machine fitting.

In a tolerably long experience in that kind of industry, covering a great variety of work, square holes were not met with, at least not to any extent warranting the employment of a special machine to make them. Oblong holes were more common, but even these are mostly of a kind that could not be drilled or cut with a tool such as is described in the patents. In connecting rods with strap joints and mortises, which make up the greater part of rectangular holes in common practice, we imagine that a cottering machine with shanks or stems as large as the hole will admit, are as nearly perfect as any implement that can be invented for cold processes.

There must be in shank-guided cutting tools a want of precision, or a difficulty in adjustment, which is much the same thing, hence in most cases, where square or rectangular holes are required, "drifts" are preferable. These make exact work, and when "pulled," instead of "pushed," can be employed of large size. At the Enfeld Arsenal, in England, drifts about one by three inches, and two feet or more in length, were employed twenty years ago in finishing the breech frame of rifles. The tools were submerged in soap and water when drawn through.

For exterior work where the size of stems or shanks for tools is not limited these square-drilling machines may have useful functions, but when we consider that this class of work is very limited in quantity if we do not include screw nuts, and even these do not require finishing on the sides, except in few cases. Well-made, cold-pressed nuts, finished on the ends only and case hardened all over, are good enough for nearly all purposes where planed nuts are employed, but, this aside, no square-drilling machine can compare with a good nut-planing or milling machine for finishing screw nuts.

In working wood, machines to make square holes are essential, because the ruling form is rectangular. In metal work the ruling form is cylindrical, and nearly all holes are round. We are strongly inclined to the opinion that these square-drilling machines for metal are not nearly so important as at first appears, or as the future will prove.

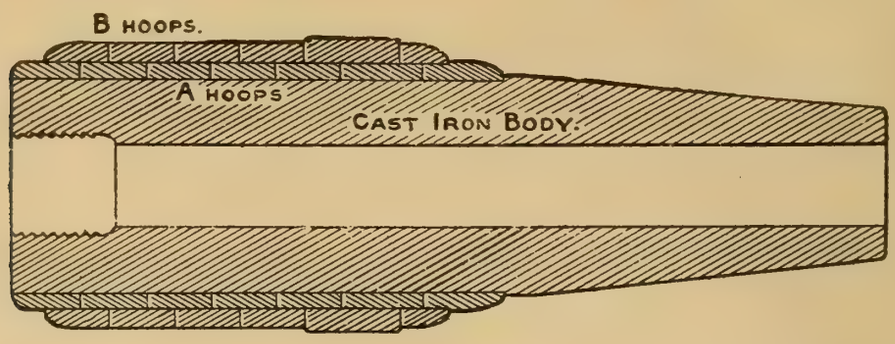


FIG. 1.

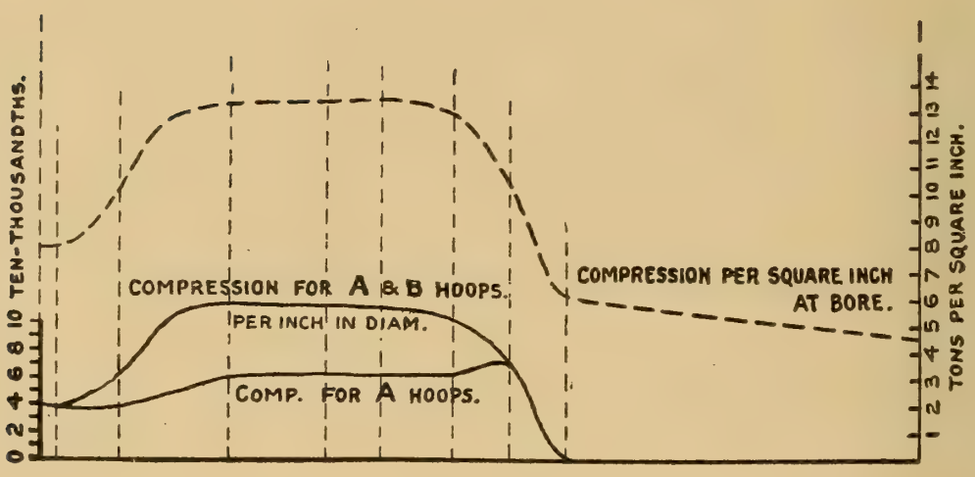


FIG. 2.

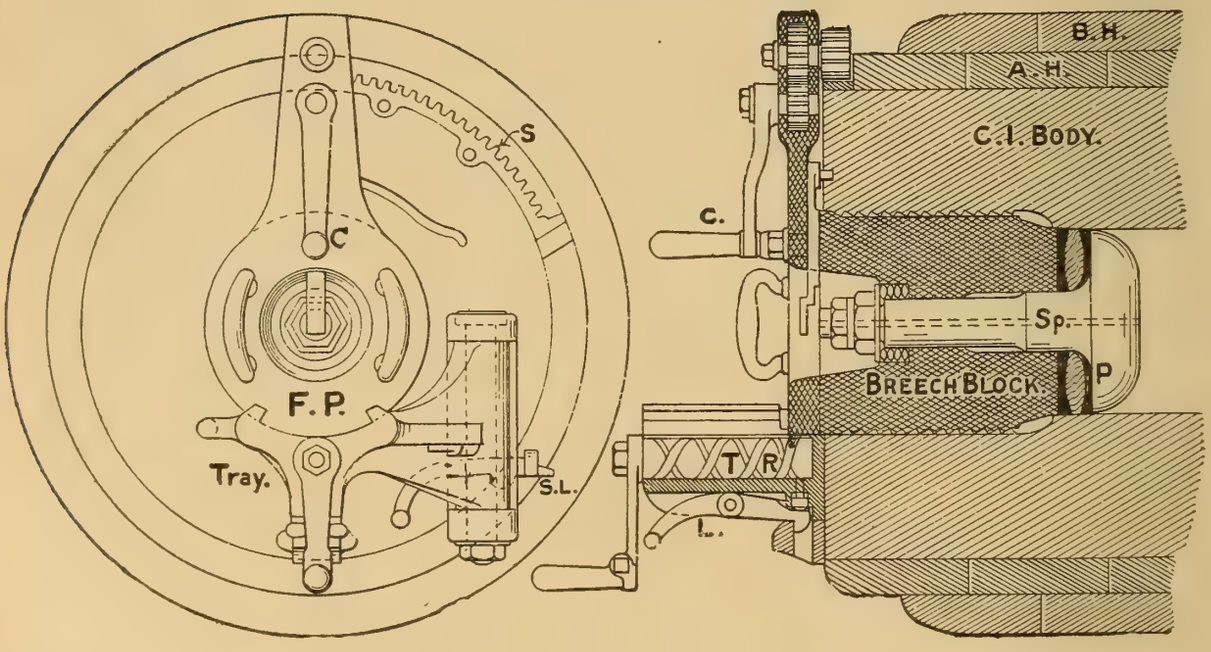


FIG. 3.

U. S. BREECH-LOADING RIFLED MORTARS.

BUILDERS' IRON FOUNDRY, PROVIDENCE, R. I.

U. S. BREECH-LOADING RIFLED MORTARS.

BUILDERS' IRON FOUNDRY, PROVIDENCE, R. I.

The makers have supplied the drawings on the opposite page, also the well written explanatory text herewith. Figure 1 is a longitudinal section through a completed gun, Figure 2 a diagram showing the static strains due to compression, and Figure 3 the details of the breech mechanism.

"In 1886 the United States Government decided to adopt for coast defense what are officially termed '12-inch breech-loading rifled mortars.' Seventy-three of these guns have been ordered at a total cost of about $600,000 dollars. The cast-iron bodies for fifty of these are being made at the works of the Builders' Iron Foundry, Providence, R. I., and orders for finishing and assembling the entire seventy-three have been given to the same company. Thirty-seven of the guns were delivered to the Government in October.

The mortars in appearance very closely resemble the steel breech-loading rifles made by the United States Navy Department, with the exception of their length, which in the rifles is about thirty times the diameter of the bore, and in the mortars only ten times.

The cast-iron bodies have a 12″ bore, are 129″ long, and 31½″ diameter, the steel hoops, which are shrunk on in two rows, are 42½″ in diameter over all.

The specifications call for the castings to be made from charcoal pig iron, and to be cast vertically, breech downward, to be cooled by the circulation of water through the core, according to the Rodman process. Test specimens cut from both muzzle and breech ends of the mortar to have an elastic limit of about 17,000 pounds, and a tensile strength between 30,000 and 37,000 pounds per square inch, or nearly double the strength of ordinary cast iron, one fifth of the entire casting to be cut off for a shrink or sinking head.

The metal is also tested for specific gravity and hardness. The latter is a comparative test, and is made by forcing a standard steel pyramid into the metal and noting the depth to which it sinks under a given pressure.

The metal is melted in what is known as an air furnace, and the iron, being separated from the fuel, is more uniform and homogeneous, and the results more reliable than could be obtained with the ordinary cupola. About six hours are required to completely fuse it, and from two to six hours longer to bring the metal to a proper state before pouring. The amount of coal consumed is about 14,000 pounds or 37 per cent. of the weight of the metal, which is nearly four times the amount of fuel required by an ordinary cupola.

The iron being tapped off flows through a long trough of fire clay directly from the furnace into the mould. As soon as the piece is cast, water is kept constantly circulating through the core, and the cooling at once commences. The top of the casting is covered with charcoal and a charcoal fire is built in the pit around the outside of the iron flask to keep the exterior from cooling too rapidly. In about twenty-four hours the core is removed and the water is turned directly into the bore of the casting for a day or two longer. The castings are made at the rate of one a week.

The casting is next placed in a gun lathe, which is of heavy build with a long boring-bar attachment instead of a tail-stock. The gun is held and driven by a large chuck on the face plate, and the other end runs in a semicircular bearing or steady rest. The boring-bar has no rotary movement, but is fed towards the face plate and carries a reamer-like cutter-head which enlarges the hole by several cuts to 11.8 inches, meanwhile, ordinary turning tools are turning down the chase or forward taper and parting off the test discs and shrink head. The tools are run in nearly to the bore, the gun body is removed from the lathe and the discs broken from the casting by wedge and sledge. The hole is next enlarged to within .1 inch of the final diameter.

The steel hoops, preparatory to shrinking are faced at the ends and bored, .003 being the allowed variation from exact size.

The outside of the body is now accurately turned to a varying diameter slightly larger than the inside of the hoops to be shrunk thereon. This difference is called the "shrinkage" and it varies along the entire length to be hooped, the purpose being to place each of the hoops under nearly equal tension. As might be supposed, the diameter of the bore is slightly decreased when the hoops are shrunk on.

Air and city gas are mixed in about the proportions of three to one by an injector and the flames play directly against the hoop both inside and out, and heat it to about 500° Fahrenheit, or to a point where a certain minimum gauge will enter, but not far enough beyond to admit another gauge .015 inch larger, the total expansion being about .09 inch in a hoop. When heated, the hoop is slipped on over the gun and up to its proper place, when, by means of the hooping press, a force of 100 tons is exerted to make a tight joint between it and the one immediately in front. A plane of water from a "sprinkling ring" is then allowed to play on the forward portion of the hoop, which soon contracts enough to grip the body. The plane of water is then moved slowly backward until the entire hoop is cold. The reader can see the necessity of cooling and hence clamping the forward portion before the rest, for otherwise the contraction ensuing would open up the joint, notwithstanding all the pressure that could be applied. The closeness of these joints may be inferred from the fact that after the exterior is turned they can seldom be detected. The exterior of the first row of hoops *A*, is now turned down as carefully as was the body, the

second row of hoops *B* is shrunk on in a similar manner, and the entire exterior is turned to the finished diameters. The hoops are so placed as to break joints.

The next step in construction is the fine boring which must be between 12.000 and 12.003 inches diameter, and straight enough to allow a test cylinder 11.997 inches diameter and 42 inches long to easily slip through the entire length of the bore of the gun.

Next comes the rifling. Few operations in machine-shop practice require as much care as the rifling of a cannon, since so much is at stake. There is no part of the most expensive steam engine but can be replaced in case of an accident during the manufacture, but here the results of months of labor may be entirely spoiled by a false cut. The body would be ruined and the steel hoops encircling it would be worthless. The necessity for extra care both in the design and operation of the rifling machine is apparent. Extra care is enjoined upon the operator, and mechanical contrivances are provided for instantly stopping the machine if any details get out of alignment.

Sixty-eight (68) grooves are cut, .379 inches wide and .07 inches deep, and these grooves have an "increase pitch" varying from one turn in 25 calibre to one in 40, the object being to avoid a too sudden initial rotation of the shot when fired. The next operation is screw threading, which is done by a special machine.

The breech mechanism is shown in Figure 3. To load the gun the breech-block is unlocked by turning the crank *C* to the right, the roller-crank is then turned, pulling out the breech-block and connecting parts on to the tray, which is then swung round out of the way. The shot is raised by a sort of crane and shoved in, the powder follows in a bag, the tray is then swung back to its first position and the breech-block is run in by turning the translating roller-crank handle, and locked by the revolving-gear handle. This uncovers the vent, where a primer is inserted, and the mortar is ready to aim and fire.

In these mortars about 80 pounds of powder will produce an initial pressure of some 28,000 pounds per square inch, and give a muzzle velocity of 1,200 feet per second to a shell of 830 pounds. This will insure a range of about six miles at 45° elevation. The shell or hollow steel shot, contains about 30 pounds of fine powder.

These mortars are to be mounted on carriages very similar to cannon carriages, except that the recoil takes place 50° from, instead of in the horizontal plane.

It is proposed to distribute them along our seaboard in groups of sixteen, to have them shielded from the enemy's ships by high earth embankments, and to fire them simultaneously by means of electricity."

Preparations are being made to mount a number of these mortars, on both sides of the harbor entrance, here at San Francisco.

EXTRACTS FROM A NOTEBOOK.

BY "TECHNO."

No. XX

[Concluded.]

————————Now I come to the end of these notes, so far as they have been shared with my friends and the public, and see before me, and with pleasure, a resumption of my studies and work in my own land, but, with a very different view of many things.

I am now convinced that our progress in this world depends greatly, if not entirely, on what others know, do and think, and there is no longer a mystery to my mind in China's standing still for some thousands of years, with a wall of masonry on the Tartar side and a wall of bigotry on all sides.

I find engineers, mechanics, and men, much the same everywhere, with like faculties, powers and traits, and have discarded my little gauge of personal prejudice for something I hope is more rational and true.

My Uncle Camshaft, who was always looked upon as a kind of fanatic, I find is after all only a sensible man, who with his duties as an engineer has been able to observe and cultivate his mind without prejudice, and in connection with people of various lands. I also begin to feel charitable toward Professors Durschnitt, Grundriss and even Eisenschlager, when I consider the broader field on which their opinions were founded.

With these views I return to England, and here in London at the Castle and Falcon, the oldest city hotel, I sit ruminating over our relations, our environment, and our future, seeing in all a new phase, even the highest, for that calling which chance has thrown in my way, and to which my humble efforts through life must be directed. My Uncle too has got into a reflective mood, because this is nearly the end of our journey, the end of it indeed, in so far as a return to English speaking people. The journey to New York is nothing ; a six-days' imprisonment with comfortable quarters and a big ship to rummage over.

I reminded my Uncle of a visit to Birmingham, Sheffield and Manchester, also Glasgow, set down in the original itinerary, to which he replied. "There are no secrets in British engineering, as soon as anyone discovers anything or improves anything, he straightway prepares a paper on the subject, and reads it before a

learned society or sends it for publication. There are bigots here as there are everywhere, but not many in our line of business, and I see no reason for trailing over works in the cities you mention, however, we will go down by Birmingham and Manchester if you choose, and if you are very anxious, go over to some of the Scotch yards and see ships in construction, but it is of no use. Each ship has a blue book of specifications that you can buy, which contains more than you could see and inquire about in a month. Everyone is curious respecting ship-building in England, and it is no wonder, the art has grown up here in a wonderful way, and will likely remain here, because there is no chance to catch up in other countries. The British do not propose to stop and wait for that purpose. By the time the French, Germans, or Americans have ships laid down to match those built here there is a new model to work to, an advance in dimensions or otherwise, that sets up a new standard.

There is a deal of twaddle written and spoken about ship-building here and the causes that have promoted it. It is evolution, skill, and being let alone; some say cheap iron in England, but it does not matter where the iron comes from. As a matter of fact most of it is imported now, in the ore I mean. Look at the Clyde, where the winter days are about eight hours long, raining a good share of the time and some days so dark that the ship yards have to be lighted with torches all the time, it is about the worst place for ship-building in the world, but they learned how to build ships by owning and working them, and do not mind a Scotch mist."

——————We went down to Birmingham. What queer places the English select for cities! It is a matter of accident. Birmingham is an accident. Set on hills, valleys, and all kinds of sidling ground. Its name too is an accident, Brumagen, it is called some times, but the name originally, was Borough Meecham, the Borough of Meecham.

The things made here would require a book to enumerate, mostly of metal, such as pens, buttons, guns, jewelry, hardware, and the like. There is not much science in the manufactures here, but a great deal of ingenuity, skill empirically acquired. For example, there is a way of eliminating imperfect spots on gunbarrels by welding in the flaws or spots. This is done only by the "barrel welders." No one else knows how or cares to learn: a double barrel gun is made in a score of places by different people, each performing their particular part. It is the old system, as we would say,

the opposite of the factory system, with advantages and disadvantages, in both a social and a mechanical sense. It leads to individuality, and that leads to a good many things desirable, but it costs more.

Of one thing there is no doubt. No people work harder than Englishmen. They work "with a will," and produce also. If not, how do they compete with their German, French, and Belgian brethren that are within sight across the channel, and no tax to keep their products out, the continental workmen receiving about half as much wages?

By the way, I have been watching this wages matter all along and find it is not the wages that governs work, but the work governs the wages, that is men are paid in proportion to what they do or produce, but that is no discovery, because how could it be otherwise? All sell in the same markets, and if the Belgians can hire a man for 75 cents a day, how can the English compete and pay $1.50 a day? This wages problem as commonly presented is bosh, it was better understood a hundred years ago than it is today.

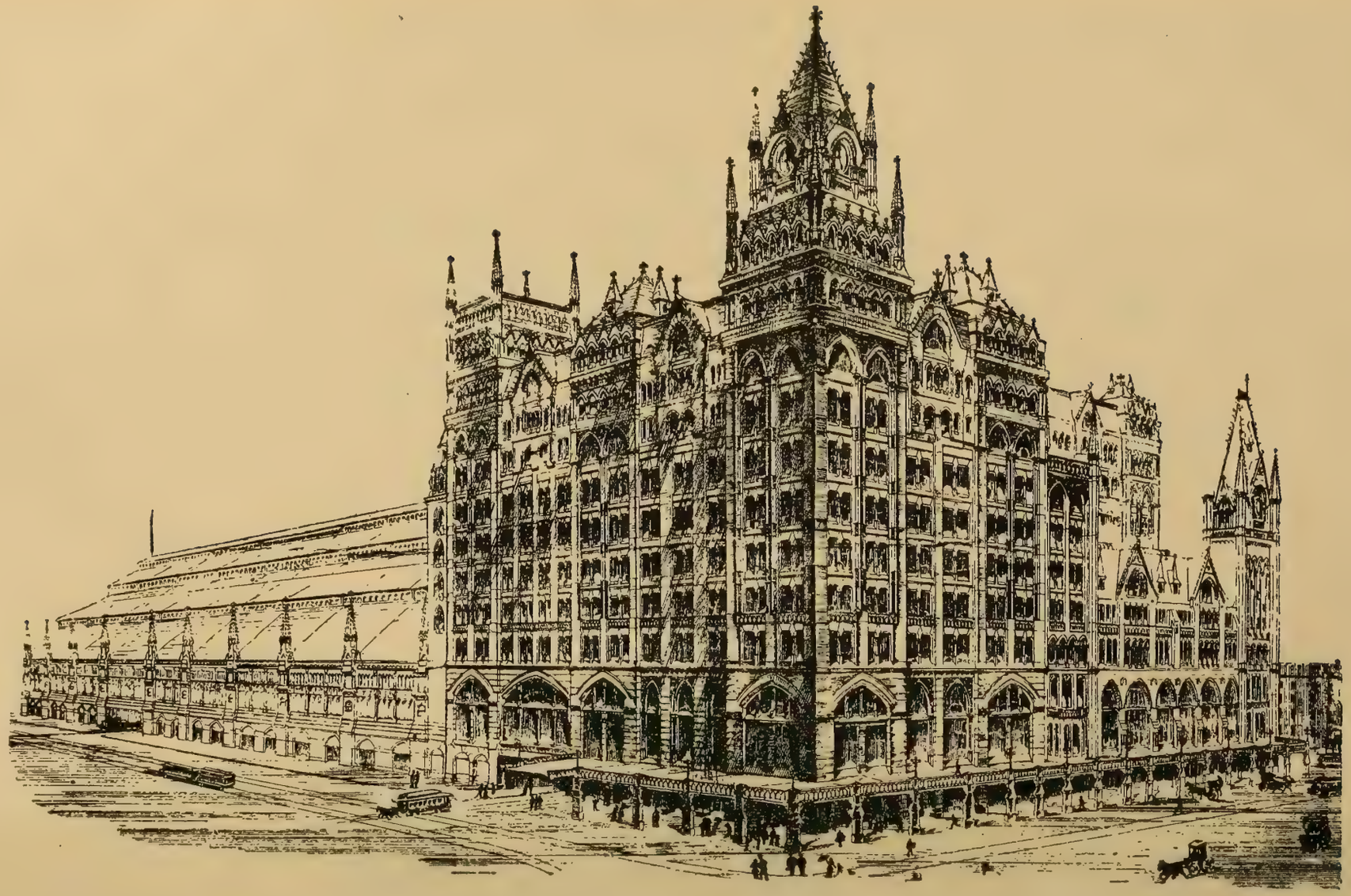
——————We went out to Soho where James Watt lived, or worked rather, because he lived and is buried at Handworth, about two miles away. James Watt & Co. have a queer old shop at Soho, old in parts but not all over. In one section there are square cast-iron line shafts with long wooden drums nearly the whole length. In other parts all is modern. One old "grass-hopper" engine was "put down by Jamie himself" as the man in charge told us. He said his father who had managed the engine had put new brasses in her, but he did not know when, before he was born forty years ago. The sewage pumping engines at Pimlico, in London, were made at the works of James Watt & Co.—about as advanced practice as can be found at this day.

The British copper pennies are coined here by contract, Mathew Bolton, James Watts partner, undertook this coining of pennies about 100 years ago, and it has gone on since. Just alongside of James Watt & Co., are the famous works of Tangye Bros., which we visited, and is here set down, all things considered, as the most advanced works of the kind in the world. My Uncle, who knew the works well, said: "They 'manufacture' engines here, others 'make' them. Tangye Bros. have built these works and made their money mainly by making American things and inventions, which were always paid for and acquired in a business manner. These methods you see here, which we call a division of labor, or the

duplicating system, is an American idea in such manufactures, but there is no chance to apply it on such a scale as this at home. We have no such market, and it seems, do not want any. These men have five hundred million of customers, when one country stops buying another begins. There are nearly one thousand engines finished and in process here, counting steam pumps. There is nothing strange in a shelf thirty feet long, covered with cross heads piled up four high, or a pile of connecting rods that reminds one of a cane shed in Louisiana. It is only in proportion to the market and a result of natural prices for material, grit, and confidence. These men are Quakers, from Cornwall, brought up to believe that they are the equals of any people, and have proved it. Put a tax of twenty-five per cent. on their iron and they would fail in a year. Their net profits don't begin to amount to half that much."

——————The social arrangements of the men, about 3,000 strong, are a revelation to me. They are like a government, have all kinds of internal provisions like a country. Medical attendance, books, insurance funds, and the like, are all provided for. The general manager, Mr. George Tangye, is a kind of leader for them; lectures, advises, and meets with them, not as a master, out of business hours, but as a citizen. The master part begins and ends with the bell. I am acquiring some rational insight of the British engineering trades and the elements of one kind or another that make up that vast interest.

——————Manchester one and all is a repetition, except that a finer grade of work is done, or rather the product is of articles demanding more precision. To comment upon industries here in an understandable way would add page after page to these notes which are now finished.



New Pennsylvania Railroad Station.—Broad Street, Philadelphia, Pa.

NEW PENNSYLVANIA RAILROAD STATION.

BROAD STREET, PHILADELPHIA, PA.

The engraving on the page opposite, for which we are indebted to the courtesy of the *Railroad and Engineering Journal*, shows the immense terminal building now being erected in Philadelphia by the Pennsylvania Company, covering nearly five acres of ground in the geographical center of the city, and the finest station in this country, if not the finest anywhere. Its nearness to the great marble city hall of Philadelphia has called for immense proportion, and the wealth of the company permits an expenditure in excellence and embellishment that will, no doubt, remain for a long time unexcelled.

In general arrangement this station is not unlike London's largest one, the St. Pancreas of the Midland Railway, in Euston Road, and if the Philadelphia one leads, St. Pancreas will, no doubt, be second, until new rivals appear. With the great resources possessed by the principal railway companies in this country, and the relations they bear to terminal cities, it is fitting that great stations of a high order should be erected and maintained, especially when, as in the present case, there is an enormous local traffic to be accommodated without disturbing the through service trains and passengers.

The station will not be completed for a year or more, and some of its interior details for the upper stories are not yet determined. The glass-covered lobby, seen around the base, is to be fifty feet wide, and is the most comfortable provision of all. No place for extensive assemblage should be without such a covered place on the sides of entrances. There will be an extensive cab stand for vehicles owned by the Company, and these are the only ones we know of in this country that are operated at uniform and reasonable rates.

Philadelphia has done much for this great railway. Formerly their station was at Ninth Street, and the principal streets were laid with their rails. Important avenues were cut off by solid embankments, and others crossed by low bridges. Now it is time the railway did something for the city, and this great building is one contribution in that way.

RIVAL COLONIES IN AUSTRALIA.

We have, in this City, a connection and interest in the Australian countries, because of our being their nearest neighbors and a new country with similar wants. Some of our merchant firms have branches there, and we have a regular steamer service between San Francisco and Australia.

The two principal colonies or countries of Australia are Victoria and New South Wales. These have each an independent government, and under circumstances as nearly identical as are likely to exist between two countries, have adopted dissimilar methods of economic management. New South Wales follows very nearly on the same plan of raising revenue adopted in England, and Victoria what is called the high-tariff principle of attempting to promote certain industries by artificial prices, and, at the same time, deriving revenue by a tax on imports. The result of these two policies has been watched with much interest, as it is now declaring itself after an experience of twenty-seven years.

Victoria in 1866 began to assess a heavy tax on imported merchandise, and otherwise undertook to look after the private interests of her people, finding, as is commonly the case, the more they were looked after the more care they required, until now the sentiment there seems to be that the government owes every man a living and must furnish it. Victoria is, at the present time, no doubt, the most disturbed and demoralized country in the world in respect to industry and the economic control of her population.

Twenty-five years ago the population was 636,982. In ten years it increased to 1,033,052, or 62 per cent. In the mean time New South Wales increased from 431,412 to 1,030,762, or 139 per cent., and this increase in New South Wales was not fairly shown by numbers, because the accretion was more largely of strong, middle-aged or young people, many of whom went from Victoria.

In 1866 Victoria had a great advantage in wealth. This has changed, and in 1881 was $990 per head for that colony, and $1,205 in New South Wales. The revenue in Victoria changed from about $16,000,000 in 1866 to $31,000,000 in 1885, 105 per cent., but in New South Wales during the same period the revenue increased 275 per cent., an increase two and a half times as great as in Victoria. The foreign trade of Victoria, from 1869, averaged, for a period

of 14 years, $171,000,000, and the increase was about $40,000,000. In New South Wales the average over the same period was $111,000,000, and the percentage of increase was four times as much as in Victoria.

In respect to shipping, Victoria had in 1866 a tonnage record of 1,325,720 tons, which, in nine years, to 1885, increased to 3,260,158 tons, but in New South Wales 1,514,735 tons increased to 4,133,077 tons during the same period, an excess over Victoria of 826,919 tons.

In 1866 the statistics of manufactures in the colonies show some wonderful discrepencies. The custom's tax was to build up manufactures, and certainly there was a fair opportunity for such a result, but in twenty years, beginning in 1866, New South Wales had more manufactures than Victoria, the products being respectively $29,000,000 to $23,215,000 in value. There were certain queer results otherwise. For example, the proportion of women working in factories was as 7.75 in Victoria to 3.49 in New South Wales, two to one. This is a significant matter, so also the fact that in Victoria six in a hundred of workmen were masters or carried on their own business, and in New South Wales there were eight to each hundred.

The immigration of people from Victoria to New South Wales has been most extensively of workmen, as the fact of their being more young, vigorous people in the latter country will show. Wages are higher in New South Wales than in Victoria. They are about the same in skilled callings, but higher in other kinds of work, but there is a progress downward in Victoria, and upward in New South Wales. In a report some years ago, or a petition we presume, because the main business of the Victorian Parliament is dealing with petitions, it was said "wages for unskilled labor average seven shillings a day in New South Wales, but any number of laborers can be had by the Victorion railways at five shillings a day."

When it comes to consumption of luxuries, which is commonly construed as a measure of the purchasing power of people, we find that New South Wales is ahead. The following table is taken from Australian statistics:

CONSUMPTION PER CAPITA.

	Tea. oz.	Coffee. oz.	Sugar. lbs.	Currants. oz.	Spirits. gills.	Beer. gals.	Tobacco. oz.
Victoria.....	110	16	92.5	98	18.3	16	35.5
New South Wales.....	117	11	102	111	20.6	16.5	46

The tariff taxes in Victoria amount to about $22 per head, and in New South Wales to $13 a head, but the duties assessed are not

of the same nature. In Victoria the tax is assessed on commodities such as are produced in the colony, so the amount can be added to the prices obtained by the manufacturers and merchants, but in New South Wales the duties are collected as far as possible on commodities not produced in the colony, so as to not disturb manufactures or discriminate between the people, and are *ad valorem.*

In respect to natural resources Victoria is much ahead of the other colony, in fact New South Wales is scarcely an agricultural country at all, and lacks the gold mines that should have enriched Victoria. For twenty years succeeding 1866 Victoria produced $429,095,080 in gold to $78,816,825 in New South Wales. In short, the differences of all kinds, except in "insolvencies," are in favor of the latter colony, and in these they are behind one half.

Late advices from Melbourne show that from the commencement of the late financial crisis there have been sixty-seven compositions with creditors in Melbourne, making total liabilities of about $24,000,000. One of the largest operators has settled at a halfpenny in the pound, or one cent on five dollars!

Mr. Daniel Strange, in his "Farmer's Manual," recently published, says: "The discontent in Victoria is the same as always follows when any government interferes with the industries of a people."

One of the most remarkable works announced for the World's Exhibition, next year, is the statue of the "Republic," a female figure 65 feet high standing on a pedestal 35 feet high. This work. if well designed, as it is claimed to be, will attract much attention because one of much difficulty, and requiring a high degree of skill in taste, design, and execution. The profile of the face is 15 feet long, and the arms 30 feet long. The statue was designed by Mr. D. C. French, of New York. Exhibits of this kind, representing the skill and taste of our people, as well as their handiwork, are entirely different from natural products in which people have had neither part nor influence in creating, and still more different from that class of morbid wonders, such as pigmies from Africa. The Exhibition, or rather the schemes for it, have much improved from the first, when the suggestions came mainly from Chicago.

BALLASTING THE SHIP "BRUNEL."

BY HUGO P. FREAR, NAVAL ARCHITECT, SAN FRANCISCO.

In March last, Captain John Metcalfe, surveyor of Lloyd's Register for the port of San Francisco, requested the writer to verify some estimates he had made as to the amount of stone ballast the British ship "*Brunel*" would require to carry a load of mixed timber to Australia.

The ship's captain reported that she was very tender, and perhaps underated her stiffness a little, and owing to his caution, and that of the agents of the ship, it was at first undecided whether to carry a deck load, as timber is carried in the Pacific coasting trade, or to fill only the hold. It was, therefore, thought best to compute the amount of ballast required, both with and without a deck load.

A British captain especially, meets with a new problem when he attempts to carry timber, as is done here on the Pacific Coast. Our coasting schooners are wide in proportion to their depth of hold, and are loaded down deep, so their decks amid ships are sometimes below the water line, the deck load and great sheer at the ends answering for freeboard. British vessels are deeper in proportion to their beam, and they generally have what is called Plimsol marks painted on their sides, which shows the maximum depth to which they can load, and also shows the maximum freeboard under which they go to sea. It has been humorously said that the Plimsol mark on our coasting schooners is placed on the mast.

It might be mentioned that a cargo of timber is one of the safest that can be carried, because it stays where placed and cannot shift.

Lloyd's freeboard is designed to be sufficient to allow a vessel to ship a deck load of water, which, according to her size, might amount to several hundred tons, which, of course, temporarily materially reduces her stability. It, therefore, stands to reason that if her deck is so loaded with timber as to exclude the water, her freeboard is increased an amount equal to the height the timber is piled, and her stability cannot be reduced from that cause. She is, therefore, in a safer condition for going to sea; or with a deck load it would be safe to load her down a certain amount below her Plimsol mark. But as Lloyd's rules do not provide for carrying deck loads of timber, it will be impossible to load her below her regular load draught. We can, however, allow her less initial stability with a deck load, in consequence of the great additional

freeboard, or in other words, allow less ballast proportionally with a deck load than without one.

There are certain statistical conditions which must exist in order that a vessel be stable and sea worthy. The point called the meta-center must be sufficiently high above the center of gravity. The distance between these two points is termed the meta-centric height. The most suitable meta-centric height varies considerably with different classes of vessels, the largest ones having the smallest amount. Records of meta-centric heights are much scarcer than they should be when it is so easy to heel a ship at the dock and find this point. Too much meta-centric height is a greater fault than too little.

Some of our coasting schooners are known to have less than twelve inches, and, perhaps, a good meta-centric height for a large ship under sail would be from thirty to thirty-six inches. After obtaining a point to start from the meta-centric heights desired for the two conditions of load will be determined, and then the amount of ballast necessary for them will be calculated. A displacement scale, a scale of meta-centers and scale of block co-efficients, together with a mid-ship section, and the dimensions of the ship, were all that was given to solve the problems. Having the meta-centers it only remains to find the center of gravity of the ship to make the balance of the problem one of simple mechanics.

The "*Brunel*," a three-masted, full-rigged ship, is 256.4 feet long, 38.95 feet beam, and 22.45 feet depth of hold. These dimensions are sufficiently close to those of the four-masted barque "*Earl of Dalhousie*" to admit of comparison. The "*Earl of Dalhousie*" is 264 feet long, 38.7 beam, 23.4 feet depth of hold. In the spring of 1885 she was lying at anchor in the Bay of San Francisco with 270 tons of coal in her hold. The captain, upon receiving a charter, decided to discharge the coal, at the same time lowering all his yards, hanging them over the side, thus hoping to retain sufficient stability to move his ship to a new berth to receive his cargo ; but unfortunately his ship capsized and went to the bottom in forty feet of water, and was subsequently raised by the Union Iron Works. The "*Earl of Dalhousie*" could be safely moved with 270 tons of coal for ballast, and a meta-centric height of six inches, would be sufficient for this purpose. Let us assume then that she had a meta-centric height of six inches, which could hardly have a greater error than two inches either way.

The "*Brunel*" is a little shorter, about the same beam and about a foot less depth of hold. She is heavier sparred, has a fuller load water line, and perhaps a little fuller bottom in proportion to her water line. The foot less depth and full water line would be in her favor, and the heavier spars and full under water bottom would be against her, but the difference in the stability of the two ships is not very great, but to be on the safe side, assume that the "*Brunel*" would have six inches meta-centric height with three hundred tons of ballast. The displacement scale reads 990 tons for the light draught, but in reality the "*Brunel*" weighed 1,100 tons with stores aboard and a swept hold. Then to ascertain the centre of gravity of the ship when empty and without ballast, assume :

Light displacement	1,100 tons
Light ballast	300 tons
Meta-centric height	6 inches
Displacement in light ballast	1,400 tons
Center of gravity of ballast above top of keel	5 feet

The displacement scale shows that the draught is 9 feet 1 inch, and the curve of meta-centers measures 13 feet 6 inches above the top of keel. Hence the center of gravity of the ship under these conditions is 13 feet above top of keel, since we assume that it was 6 inches below the meta-center. Then the center of gravity of ship without ballast in feet =

$$X = \frac{300\ (13-5)}{1100} + 13 = 15.18 \text{ feet}$$

above the top of the keel. The movement being taken about the center of gravity of the ship in light ballast.

While this center of gravity is not absolutely correct because it has been calculated from assumed facts, it is sufficiently accurate for all practical purposes and will be used as a base for the balance of the problem. From the curve of block co-efficients the capacity of the hold was calculated, and it was estimated that 1,000,000 feet of timber could be stowed in it. It was assumed that 750,000 feet of this would be green red wood at 4½ pounds per foot stowed in its bottom, and the balance, 250,000 feet of Oregon pine at 3 pounds per foot placed on top, which together made 1,840 tons. The center of gravity of this lot was placed at 16 feet above the top of keel. It was also estimated that 268,800 feet of Oregon pine at 3 pounds per foot, or 260 tons, would constitute a deck load. The center of gravity of this was placed 29 feet above the keel. Then

the center of gravity of ship and total cargo without ballast, in feet, above top of keel =

$$X = \frac{1100 \times 15.18 + 1840 \times 16 + 360 \times 29}{1100 + 1840 + 360} = 17.14 \text{ feet,}$$

and the center of gravity of ship and cargo in hold only, above top of keel, in feet =

$$X = \frac{1100 \times 15.18 + 1840 \times 16}{1100 + 1840} = 15.69 \text{ feet.}$$

It is now necessary to determine what meta-centric height we will aim to attain for the two conditions of load, and then calculate the ballast to suit. Again referring to the "*Earl of Dalhousie*" for data, her plain sail area was 23,872 square feet, and that the center of effect of the wind was 58 feet above the deck. From this it was assumed that the plain sail area of the "*Brunel*" was 23,000 square feet and that the center of effect was 74 feet above the center of lateral resistance.

It was decided to allow her a steady angle of heel of 8 degrees with a deck load, and 5½ degrees without a deck load, under a wind pressure of one pound per square foot. The greater angle for a deck load was allowed for reasons already stated. From this the respective meta-centric heights desired can be calculated, assuming the amount of ballast to get approximately the displacements, and also assuming that the meta-centric heights will be practically constant for these angles. In the first case assume sufficient ballast to bring her down to her load, which gives a displacement of 3,900 tons, 600 tons being ballast. Then 3,900 × 2,240 = 8,736,000 pounds; and 2,300 × 74 = 1,712,000 foot pounds of wind pressure.

$$\frac{1,712,000}{8,736,000} = .196 \text{ feet} = 2.352 \text{ inches} = \text{righting lever of ship at } 8^\circ \text{ angle.}$$

$$\text{The meta-centric height of G M} = \frac{2.352}{\text{Sine 8 degrees}} 16.90 \text{ inches.}$$

In the second case assume 520 tons ballast which gives a displacement of 3,460 tons, and 3,460 × 2,240 = 7,750,400 pounds, and

$$\frac{1,712,000}{7,750,406} = 2209 \text{ feet} = 2''.6508 = \text{righting lever of ship at } 5\tfrac{1}{2}^\circ \text{ angle of heel.}$$

$$\text{G M} = \frac{2.6508}{\text{Sine } 5\tfrac{1}{2} \text{ degrees}} = 27''.61$$

As has been said there are many timber vessels on this coast whose meta-centric heights would fall far short of the G. M. which the above assumptions and calculations have led the writer to select,

and furthermore, if the "*Brunel*" was going in the coasting trade instead of the Australian, a larger angle of heel might have been selected, and a smaller meta-centric height used.

The amount of ballast was determined by trial calculations, or in other words, the ballast was assumed and then it was ascertained whether the meta-centric height was sufficiently close to those we had settled on. As above, with a deck load, assume 600 tons ballast. Then the center of gravity with ballast =

$$C\ G = \frac{3300 \times 17.14 + 600 \times 5}{3300 + 600} = 15.26 \text{ feet}$$

for its height above top of keel. The meta-center on this displacement according to the scale is 16.66 feet above top of keel, giving a meta-centric height of 1.4 feet or 16″.8, which is about what is required. For a hold cargo only, assume 500 tons ballast, then

$$C^1\ G^1 = \frac{2940 \times 15.69 + 500 \times 5}{2940 + 500} = 14.13 \text{ feet above the top of the keel.}$$

The meta-center on this displacement is 16.41 feet above top of keel, giving a meta-centric height of 2.28 feet or 27″.36 practically the height desired. 600 tons ballast is then required for carrying a deck load, and 500 ballast for a hold cargo only. It may be stated the amount of ballast, both for determining the meta-centric heights, and also to see if we had the meta-centric heights desired, were not assumed so closely at first, but trial calculations were first made so that they could be assumed within close limits. The heights of the centers of gravity of the various amounts of ballast were all placed 5 feet above the top of keel, the ballast in every case being trimmed the same height, but over a greater length of the vessel. It was finally decided not to carry a deck load. 550 tons of ballast were placed aboard. The actual cargo consisted of 487,000 feet of red wood; 96,280 feet of sugar pine; 488,696 feet of Oregon pine; 33,338 feet of yellow pine; 1,250 doors, equal to 30,000 feet; 20 barrels of oil; 4 carriages in crates. The mean draught ready for sea was 19 feet 2½ inches.

Before the "*Brunel*" sailed Captain Metcalfe suspended a weight at the main top sail yard arm, and satisfied himself that she was in sea-going trim. The displacement, according to the scale, was 3,600 tons, or 60 tons more than calculated, but it will be noticed that 50 tons more ballast was placed aboard than estimated, so that the dead weight of cargo was within ten tons of that estimated. The 50 tons extra ballast were put aboard because there was to be less red wood, and it was thought the center of gravity of

the cargo would be a little higher. The position of the various calculated centers of gravity and meta-centers in the mid-ship sections are according to the following numbers :

(1)	C. G. of ballast	5.	feet above keel.	
(2)	C. G. of ship light	15.18	"	" "
(3)	C. G. of cargo in hold	16.	"	" "
(4)	C. G. of deck load	29.	"	" "
(5)	C. G. of ship and total cargo	17.14	"	" "
(6)	C. G. of ship and hold cargo	15.69	"	" "
(7)	C. G. of ship, total cargo and ballast	15.26	"	" "
(8)	Height of meta-center for (7)	16.66	"	" "
(9)	C. G. of ship, hold, cargo and ballast	14.13	"	" "
(10)	Height of meta-center for (9)	16.41	"	" "

The captain of the ship, on arriving at Australia, reported that he had a comfortable voyage, but thought the "*Brunel*" was a little tender, this was, however, as intended.

THE FLOW OF WATER IN PIPES.

Mr. William Cox writes to the editor of *Engineering*, London, as follows : "I take the liberty of submitting herewith a new and original formula for ascertaining the loss of head in pipes by friction, which, while being very much simpler than Wiesbach's, gives almost identical results." The formula is as follows :

Let L = length of pipe in feet. V = velocity in feet per second.
D = diameter of pipe in inches. H = friction head in feet.

$$\text{Then } H = \frac{L}{1200\,D} \times \left\{ 4\,V^{\frac{1}{2}} + 4\,V + V - 2 \right\} \text{ or } (4\,V^2 + 5\,V - 2).$$

The formula may be further simplified by reducing it to

$$H = \frac{L \times C}{D}$$

in which C is replaced by the following value, according to the velocity :

Velocity, 1 ft.	C = .00583	Velocity, 6 ft.	C = .1433
" 2 "	= .02	" 7 "	= .19083
" 3 "	= .04083	" 8 "	= .245
" 4 "	= .06833	" 9 "	= .30583
" 5 "	= .1025	" 10 "	= .3733

In the last form given this rule is very simple and easy, if one has at hand a list of the values of C, but it is usually more convenient still to use worked-out tables, such as were printed in this Journal three years ago, and since then extensively employed on this Coast.

LAW COURT DECISIONS.

INDUSTRIAL MATTERS AND PATENTED INVENTIONS.

Injuring Machinery Sold Conditionally.

"Where the purchaser of machinery, by the terms of his contract, has a reasonable time after he receives it to make known its defects, but instead of doing it he keeps and uses the machinery for some length of time, and until the seller seeks to recover the property under the contract, because of failure to pay for it, this is a ratification of the contract by the purchaser even if the machinery was defective. And in such suit to recover the machinery the seller may introduce evidence that the purchaser has used the property from the time of its delivery to him, and that it has been greatly damaged by such use, other than the deterioration from attempting to use the machinery in a proper way, and be allowed therefore."—*Huyett & Smith Manufacturing Company vs. Gray, Supreme Court of North Carolina, 15 S. E. Rep. 939.*

When an Injunction will be Denied.

"In a suit for infringement, when the case is not free from doubt, and the experts are at variance, and there are no prior adjudications, a preliminary injunction will be denied, especially if defendants are amply able to respond to any damages that may be adjudged against them on final hearing."—*Ironclad Manufacturing Co. vs. Jacob J. Vollarth Manufacturing Co., U. S. Circuit Court, Wisconsin, 52 Fed. Rep. 144.*

Enlargement of Patent Claims.

"Where an inventor makes a generic invention and also subordinate specific inventions, and presents the whole series in a set of contemporaneous applications, he cannot be allowed, by subsequent amendments couched in general terms, to enlarge the boundaries of each invention so as to extend each into the borders of another, and thus obtain a series of overlapping patents."—*Electrical Accumulator Co. vs. Brush Electric Co., U. S. Circuit of Appeals, 2nd Cir., 52 Fed. Rep. 131.*

Employes and Dangerous Work.

"While it is the duty of an employer, whether a railroad company or other corporation or person, to make the work of its employes as safe as is reasonably practicable, yet when the employe, with full knowledge of all the dangers incident to or connected with the employment as it is conducted, accepts the employment, or having accepted the same, continues in it with such full knowledge, and without any promise on the part of the employer, or any reason to expect on the part of the employe that the employment will be made less dangerous, the employe assumes all the risk and hazards of the employment. And where the employe knowing the dangerous character of the work which he is required to do, undertakes the same, although unwillingly, for fear of losing his employment, and is injured, he has still no cause of action against his master."—*Southern Kansas Railway Co. vs. Moore, Supreme Court of Kansas, 31 Pac. Rep. 138.*

Enlargement of a Patent Claim.

"Letters patent No. 171,425, issued December 21, 1875, to John C. Reed, for the non-conducting covering for "boilers, steam, water, and other pipes," claimed a covering composed of layers or wrappings of paper saturated with adhesive material, and compressed while being formed into tubular sections "of a thickness of one half inch or more, substantially as described." A reissue of the patent—No. 8,752, granted August 10, 1879—omitted from the claims the quoted words. This was an enlargement of the claim, rendering the reissue invalid, and this effect could not be avoided on the theory that a covering of less than half an inch would not constitute the "thorough non-conductor" of the specifications; for, while a less thickness might not be sufficient for boilers and steam pipes, it manifestly would be for "water and other pipes."—*American Heat Insulating Co. vs. Johnson & Co., U. S. Circuit Court of Appeals, 52 Fed. Rep. 228.*

Construction of Patent with Respect to Assignor.

"Where a patentee assigned all his interest in a patent, agreeing not to manufacture or sell the patented machine, or make any improvement thereon which would adapt it to any other kind of work, and subsequently the assignee sued him for infringement in making an improvement on the machine, it was decided on motion for preliminary injunction, that in the light of the above contract, although the suit was not based thereon, the patentee was not in so favorable a position before a court of equity as one who infringes ignorantly or inadvertently, and that the patent should be construed liberally as against him."—*Loring vs. Booth, U. S. Circuit Court, New York, 52 Fed. Rep.*

Elevators in Buildings.

"City ordinances requiring elevators to be built and protected in a certain way, and to be periodically inspected, do not create a civil liability against a person who violates them towards one who is injured by an accident that was in no way caused by such violation. And a city ordinance which requires machinery that is so located as to endanger the lives and limbs of those employed in the building to be so covered or guarded to insure against injury to such employes, gives no right of action to an injured person who is not an employe, as where such a person is injured by the counterweight of an elevator."—*Gibson vs. Leonard, Supreme Court of Illinois, 32 N. E. Rep. 182.*

Sale of Good Will.

"When a person sells to another the good will of his business of a particular kind, and agrees not to enter a like business in the same place while the latter, or anyone deriving the title to the good will from him, is engaged in such business, and later he engages in a general merchandise business in that place, and among other things, sells articles which are also sold in his former particular business, is an action for breach of contract, he can show that such articles do not belong especially to such particular business, but are articles of general merchandise, to sell which would not be a violation of his contract."—*Prior vs. Diggs, Supreme Court of California, 31 Pac. Rep. 155.*

Accumulating Water or Electricity.

"It cannot be questioned that one has the right to accumulate water upon his own real property and use it for a motive power; but he cannot discharge it there in such quantities that, by the action of physical forces, it will inundate his neighbor's lands and destroy his property, and shield himself from liabilities by the plea that it was not his act, but an inexorable law of nature, that caused the damage. So if a person collects for pleasure or profit the subtle and imperceptible electric fluid, there would seem to be no great hardship in imposing upon him the same duty which is exacted of the owner of the accumulated water power, —that of providing artificial conduit for the artificial product, if necessary to prevent injury to others."—*Hudson River Tel. Co. vs. Watervliet Turnpike & R. Co. 32 N. E. Rep. 148.*

Drainage.

"The owner of higher land is not authorized by the law to dig through or remove natural barriers, and thereby let on to adjoining lower lands water that would not otherwise naturally flow in that direction. And in case he attempts to dig it, where it is reasonably certain that the proposed act of the proprietor of the higher lands will cause a substantial and irreparable injury to the private rights of the owner of the lower land by creating a private nuisance on his premises, a court of equity will afford relief by decreeing an injunction."—*Graham vs. Keene, Supreme Court of Illinois, 32 N. E. Rep. 180.*

When Tenants Cannot Remove Fixtures.

"Unless provided for by the statutes of his state, or by special contract, a tenant has no right, after the expiration of his term, to remove articles of property affixed by him to the demised premises for purposes of trade. Articles so affixed and so left after the expiration of the lease, without any agreement with the owner of the demised premises, become his property absolutely. A purchaser of such trade fixtures from the tenant takes subject to the same conditions for he only buys what the tenant has a right to sell."—*Sweet vs. Myers, Supreme Court of South Dakota, 53 N. W. Rep. 187.*

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COMMENTS.

If the report is true, nothing has happened for years past so discreditable to employed men as the projected strike of the city railway men in Chicago next spring at the opening of the exhibition. Men have generally been content with an assumed claim of equity and fairness, in their demands, but to avail themselves of an emergency to force higher wages is infamous, and it would be curious to know just what the reasoning was in the matter. A demand of extra pay for extra service during the crowded traffic would be reasonable enough, if fairly presented, but a threat to impede public travel and traffic on such an occasion to exact increased pay, shows a dangerous spirit abroad in the land. Robbery within the pale of the law is no better than robbery in violation of law, when the effect upon the person robbed is the same. This is one case of a proposed strike in which no one can find an excusing circumstance.

The development of two transcontinental routes in the northern part of the United States, and one still north of that in Canada, in the cyclone path, and traversing regions of ice and snow in winter, on courses that are much longer than if constructed fifteen hundred miles to the southward, is one of the strange problems of our day. The local traffic, present and prospective, national boundaries and an energetic population in the northern belt, are no doubt the

main reasons for the northern railways, but in so far as an European route to Asia and Australia, if one takes a map and looks it over, an inference will be that the true transcontinental route is along the 35th parallel through the Southern States from Charleston or Savannah to San Diego on this Coast. It is true the Southern Pacific Company with their lines to the Gulf of Mexico in a manner constitutes such a railway line, but for some reason has failed to secure their proportion of European travel across the continent, still a southern line will come sometime.

There is a good deal of space wasted in our American journals in explaining how there is a tendency to what is called "protection" in England, and certainly with scant knowledge of conditions there. As in other countries, certain people there would like protection for what they sell, and free trade for what they buy. There are what are called protectionists in all countries, and always will be, those who are willing to advance their own interests at the expense of their neighbors, but anyone who understands the laws and commercial principles on which business is done in England will know how impossible a return to indirect taxation would be. Their Parliament, the sovereign power, would not dare to disturb the jealousy of personal rights that is so prominent in all affairs of trade. The Postmaster General can not make a contract for mail service without having his procedure brought up in Parliament and overhauled to see if the service is paid for at a rate to discriminate against other lines, not carrying the mails. To increase the price of any home manufactured product by a duty would raise a whirlwind of protest. Duties can be and are assessed on commodities not produced in the United Kingdom, but this does not of course discriminate between home industries.

Mr. F. M. Holland, in *Open Court* of December 1st, 1892, says of the discovery of America by Columbus, that the *Matthew* sailed from Bristol, England, July 3, 1497, to Greenland, over the course of Lief Ericsson, then south-west into the Gulf of St. Lawrence and landed at Cape Briton and set up the flags of England and Venice. This, says Mr. Holland, was thirteen months before any part of the mainland was known or seen by Columbus, and was twenty years before any Spaniards landed in Florida, also, that this discovery of Canada by the English was confirmed by various explorers from that country, including Baffin, Drake, Hudson, and John Smith. The

discovery in the Gulf of St. Lawrence was at day break on St. John's day. One of the Cabots, John or Sebastian, was in the *Matthew*. Edmund Burke once claimed that "we derive our rights in America from Sebastian Cabot, who first made the American Continent in 1497." It is curious how five hundred years can destroy history, even within the period of recent history.

The President of the United States has again stirred up the sorry subject of "retaliation," in recommending inspection of goods in transit between American ports, aimed as usual, at the commercial interests of this Coast, because the case is that of goods coming here to be reshipped to Vancouver and carried across the country by the Canadian Pacific Railway. The almost certain result is that such goods will be taken direct to Vancouver instead of to this port, to our loss, and with no possible compensation. There seems to be nothing neglected that will tend to build up Canadian commerce on this or the Atlantic Coast. The way to hold the trade for our own routes is to carry it at lower rates, which is certainly possible, and when any wrong is done, demand redress without such an admission of weakness as retaliation always inplies. It is a procedure hateful in name and nature, not becoming a great nation, or any nation.

"The Limits of Legitimate Religious Discussion" by the Bishop of Delaware, in the *North American Review* for December, will, in the opinion of many, transcend the limits fixed by itself, and violate the very rule which the object is to set up. The Bishop after quoting such legal decisions bearing on religious matters as the records of this country show, and which are mainly against attacks upon christianity, he easily slips over into the divinity of Christ being an essential component in what the term of christianity implies, forgetting, perhaps conveniently, that a large number of religious and even christian people, in this country, do not admit the divinity of Christ nor believe it is taught in the scriptures. It is a grievous thought to many, perhaps all the leading churches, that the Government does not recognize and enforce their particular faith and tenets and fix a limit to religious discussion. The limit of common courtesy and the dependence of a publisher's profits on his observing the deference due to widely held opinions, is quite enough. Anything more would be protection applied to doctrines.

The Morgan Nicaragua Bill, before Congress, if correctly explained, goes a good way in avoiding the objectionable features of the first one. Under its provisions the government is to hold 80 per cent. of the shares, and appoint ten out of fifteen directors, but the main features and gain, is the provision that the work is to be done by government engineers, and not by a construction company, composed of the same people who are the Nicaragua Canal Company. Every one will be pleased at any measure that will promote and carry out this important work at a reasonable cost, in an economical manner, and leave the tolls to be fixed by an Act of Congress, but there remains to be explained how the present concession to the Nicaragua Canal Company will fit the Congressional Bill as it is now framed.

The Hon. James Bryce, now a minister of the British Government, the author of "The American Commonwealth," has contributed to the *North American Review* for January, an essay on "Political Organizations in the United States and England," which, like all of his writings, is carefully smoothed off, sand-papered, and finished with an unctious coating, so as to be agreeably swallowed by anyone on either side, or by anyone on neither side. Much information is given in the way of facts, which serve as means of invidious comparison by readers in both countries, but of opinions, suggestions, and criticisms, none whatever. We are tired of Mr. Bryce's writings, framed and squared to please everyone. Optimism is pleasant but is not progressive or profitable. If there is anything more contemptible than English politics of our day, it is American politics, both are merely expedients to draw out or force so much honest action as will in a manner protect people from outrage and robbery. The method and nature of modern politics is not a subject demanding essays so much as some way to get rid of nine tenths of all that is included in the name.

The Treasury reports for December continue to show a continued falling off in exports and a like increase of imports. In July of last year, the decline in exports was $4,267,000; in August, nearly $8,000,000; in September, $20,000,000; October, $15,000,000; and November, $13,000,000; showing a relative change between exports and imports of "sixty millions" in five months. Imports on the contrary increased all the time, gaining from July to December of last year $48,000,000, compared with a like period of 1891.

This is in accordance with a claim we have had the temerity to make respecting this and all other countries, that a high duty on imports does not prevent importation for any length of time, and not at all if the home prices are advanced to cover the duties on imported articles. The quantities above are quoted from the *Nation*, taken from a recent report of the U. S. Treasury Department. The result may not mean any disadvantage, on the contrary is a necessity just now, because the revenue is needed, or at least is spent. The pension list for this year will amount to about $175,000,000. The names on the pension roll amount to 1,046,893, and more than were ever on the army roll at one time.

The value of statistics has been sorely impeached by a recent circumstance that goes to show how little care is exercised in both facts and conclusions. Mr. Edward Atkinson, it is said, some time ago claimed that all farm mortgages incurred in the Western States prior to 1880 were paid out and half of them since given have been liquidated. We cannot conceive of Mr. Atkinson saying any such thing. It is preposterous. It is doubtful if one fourth of the mortgages of 1880 have been paid out in Kansas and other Western States, but this is not the point to be noticed here. The agent of the Porter Census Bureau says the recorded indebtedness of farms in the West increased 155 per cent. in the last decade, and from three to nine times as fast as the wealth of the country. In the South the increase of mortgages was 261 per cent, and twenty-four times as much as the increase in population. It would be hard to institute an arithmetical relation between these two propositions, but not hard to arrive at a definite value of both of them.

INDUSTRIAL NOTES.

There is, it seems, a good deal of difficulty in maintaining the bearings of supporting sheaves for rope ways or telpher lines, and we are quite prepared to believe that such bearings are not made as they should be. Metaline, graphite and other kinds of dry bushing may answer when there is not much pressure, but there is always a problem of quality to be contended with. The best way is to make the studs hollow, with a central bore equal to half their diameter, so arranged that this central chamber can be filled with grease of proper consistency. In the bottom of

the studs there should be drilled a number of holes, or a slot made at the center of the bearing, communicating with the grease chamber, so the latter can run out as required. On the feeding side a piece of vertical pipe with a plug resting on the hard grease will indicate a mile away if by any chance a bearing heats so as to run the grease all out, also will show the rate and amount of consumption. We are speaking from practical experience in similar cases where such bearings caused no trouble under heavy strain.

The Engineering and Mining Journal says the high bridge over the Pecos River, in Texas, that cost $1,200,000, built to shorten the distance 11 miles between San Antonio and El Paso, Texas, has been abandoned by the Southern Pacific after using the route two weeks. The bridge was built by a private corporation, in which C. P. Huntington was a small shareholder, that was to receive fifty cents toll on each passenger. It is surmised that this astute manipulator is trying to destroy the value of the shares, and then buy them in. Supposing this conjecture to be true, and that the bridge was constructed with his coöperation and an implied use by the Southern Pacific Company, it will be hard to distinguish between the abandonment of the bridge and the Jay Gould method of acquiring it. Since the above statement appeared it is reported that the Texan Railway Commissioners would not permit the toll to be collected, but this leaves the circumstances very much the same.

The Defiance Machine Works, at Defiance, Ohio, have "defied" common practice to the extent of making a rational shop stove for heating. This means a plain vertical cylinder with spheroidal ends, the walls of which are thick enough for a stove 24 inches in diameter to weigh 837 pounds. We once had some experience many years ago in this same thing, and after a provoking attempt to warm a large shop with "tin-pot" contrivances, a stove was procured from a foundry not very far from Defiance, 1¼ inches thick. It is, no doubt, doing duty yet, at any rate five years of use made no impression on it. There were no embossed eagles, fresco work, or thermostat attachments, but there was enough iron to secure slow heating and slow cooling. This meant comfort and long service. The modern tin-plate stove is an abomination; either red hot or cold, and needs a successor after each year of service. The plates of a shop-heating stove should not be less than an inch thick.

An English engineer has worked out an efficiency formula for steamship performance as follows :

$$\frac{\sqrt[3]{D^2 \times V^3}}{K} = \text{efficiency, or the coefficient of performance.}$$

D equaling the displacement, V the speed of the ship and K the fuel consumed. By this rule the *City of Paris* and the *City of New York* have the best record among the transatlantic steamers. The *Teutonic* and *Majestic* come next, and then the *Oceanic*, running now out of this port. This is flattering to Harlan and Wolff, the builders, because the *Oceanic* has been in commission twenty-three years.

The high chimneys, 50 feet or more above decks, of ocean steamers are probably the residual of the forced draught system, in so far as the merchant service is concerned. The fact of having to transport fuel and heavy boilers for long runs, taking the place of paying cargoes, has been a powerful incentive in a search after an economy that has, no doubt, been overdone, and the true limit of intensity for firing is within the draught that can be attained by high chimneys, at any rate present opinions tend that way. Since there appears no great difficulty in staying such chimneys, the wonder is that those of passenger ships have not been lengthened so as to avoid cinders and soot. In a ship 500 feet long, a chimney of 30 feet or so causes a "mess" when the wind is ahead or aft, especially the latter and the ships are moving at the same rate as the wind.

We may some day find out in how many forms a water-tube boiler can be arranged. Nearly every week brings out a new design, and from the first to the last the difference does not seem a great deal. There is an insuperable impediment to be dealt with. The gases of combustion want to go upward, so does the steam in a boiler. This brings the most intense heat in contact with the solid water in the lowest part of the boiler, and rapid evaporation is apt to "throw the water out." To reverse the course of the hot gases, and the steam, we find the water tubes usually set in an inclined position so the flames or gases will cross the tubes transversely. Down draught, is especially favored by this form of water-tube boilers, not down draught through the grates, but in the flues beyond the grates, and there seems no sufficient reason for the diagonal tubes that are found in nearly all water-tube boilers. As a type they are a sequence of high pressures, also "high speed," and characteristic of our time.

Sir William Armstrong, who is not a great steam engineer, but a shrewd observer, said, some years ago, that "if the entire energy of a good condensing steam engine was divided up into ten parts, two of these parts would escape by the chimney, one part being consumed by radiation and friction, six parts remain unused when steam is discharged; only one part is realized in useful work, in other words, 90 per cent. is lost." By total energy Lord Armstrong meant, of course, the energy in the fuel, not of the steam. These losses are much more than nine tenths in average cases, and taking one engine with another in common use, it is much nearer the truth to say nineteen twentieths of the heat is lost. Gas engines do better than this, some of them a good deal better, but results are yet too erratic to assume a standard for "internal combustion engines."

There are in some American cities, St. Louis for one, ordinances requiring the employment of licensed engineers. We do not know the precise nature of these ordinances, but as they enforce a system of boiler inspection, and the employment of members of an association, it would seem fair that the two things should be combined, that is, if an owner is obliged to employ an engineer having the warrant of his qualification from a board or association, that body should become responsible for his errors, and why not pay to the licensing body the insurance premiums? In other words, why should not boiler insurance include the licensing of engineers who are to have charge of the boilers? The two things seem to belong together, and we see no reason why a city as a corporate body should not insure boilers. It seems anomalous that one authority should determine who is competent to have charge of a boiler, and another authority warrant his efficiency, or insure boilers, which is nearly the same thing.

At the late meeting of the American Society of Mechanical Engineers, in New York, Mr. G. W. Bissell, of Ames, Iowa, presented a paper on "Strains in Lathe Beds," and if the sections, shown in the drawings, are a component in the results, a good many people will think the time wasted in so far as arriving at "resistance." The main point, however, was to ascertain tool stress with other operating conditions, and that far is valuable and a contribution in a new field, but what we wish to point out is the disposition of the metal in the main frames in respect to torsion, the principal strain that frames have to endure. A ladder frame, that is, two side mem-

bers and cross girts with open spaces between is as near a wrong section for a lathe frame as can be devised, and it is a pity that Mr. Bissell did not apply torsional strain directly to the ends of the frames and note the results. If he had done so, and then tried the same experiment on a continuous closed frame of any section, he would have discovered, as Professor Sweet demonstrated years ago, that there was scarcely comparison in the case, and that a closed or box frame is, in respect to torsion, about five times as rigid as the common form.

In hauling some of the Broadway cable-railway plant, in New York, the load on each wheel of the truck had to be ten tons, and the result was serious for the streets, sinking them in some places a foot. In St. Louis a heavier load, equal to fourteen tons on each wheel, caused no injury whatever on what is called the Telford pavement there, but the St. Louis' streets had a foundation beneath the covering, and in New York they had not. Here in San Francisco the paving stones would have been pushed down out of sight in the sand. The loads were excessive in both cases, but not much worse, all things considered, than a narrow-wheel truck with two tons on a wheel. In either case a bad street would be destroyed.

Mr. Josiah McGregor, of London, has had the temerity to change wholly the type and design of stern-wheel steamboats, and has certainly produced what is a more rational vessel than our native "wheel-barrow" boats. Instead of putting the boilers at one end, and the engines at the other, he places them together in the center of the boat, and extended the piston rods back to crossheads near the wheel. This costs but little, avoids long steam pipes, and places the engineer where he can watch all of the machinery. The wheels are divided into two parts with the cranks between. This gives two bearings to each shaft, and leaves the outer ends clear to accommodate the links for feathering paddles, a very complete and neat arrangement. The engines are compound and condensing, of 200 horse power, with cylinders 18 and 31 inches bore, 42 inches stroke, operated at a pressure of 150 pounds per inch. The cylinders are set one in advance of the other so as to bring the piston rods as near together as possible. These boats are 125 feet long, 22 feet wide, to draw 20½ inches light, and run at 12 miles an hour. A number have been built for the Argentine Government.

Mr. F. W. Johnson, of the Central Mexican Railway, has designed, and had constructed at the Rhode Island Locomotive Works, a double or Fairlie compound locomotive that *Locomotive Engineering* says is the largest one in the world, a rating that depends on whether the engine is considered singular or plural. For an ordinary person it looks very like two locomotives butted together, and rigidly connected. To a mechanic it will be a problem to understand why the engine is made in "one piece," so to speak. For our own part we reserve the privilege of believing that there would be an advantage in cutting the structure in two, and putting a flexible connection and foot plate between. The weight of the two engines combined is 130 tons. It is intended for climbing the steep grades of the line, which occur in the mountain divisions.

Engineer J. H. Jones, of the North Pacific Coast Railway steamers, when having the boilers of the steamer *San Rafael* overhauled last year, had a kind of pocket built on the inside of the main shells at one side, into which the feed water is pumped, and from which the sea blow-off leads out. This pocket consists of a sheet about 3 feet wide flanged at the sides, and riveted to the main shell inside, leaving an annular space around the side of the boiler, 30 × 2½ inches, the top or overflow being a little higher than the flues. The area of this chamber being about forty times that of the feed pipe, the water injected rises slowly, is thoroughly heated, and precipitates nearly all of any mineral substance it may contain before reaching the main body of water in the boiler. Several times each day the blow-off valve is opened for ten seconds or so to keep this intake chamber clear. A handhole is provided for inspection, and the cost of the whole was about $35 on each boiler of 300 horse power. The idea is neat, effectual and inexpensive.

It is not often that turning mandrels are spoken or thought of as an element in maintaining standard sizes in machine works, but they are in fact a key to the whole system. A set of mandrels hardened and ground for small holes, and with hardened centers for larger holes, will force the reamers to be maintained "to gauge." Holes determine the size of cylindrical parts, and if these are not accurate as to diameter and straightness such work as is to be turned can not be dealt with, because of its not fitting on mandrels, so, as before said, the system goes back to these implements. The earliest notice of a reamer being under size is that the holes made by it will

not receive the mandrels, or else are too large to fit, still we hardly ever hear mandrels mentioned in the various writings on the subject of standard dimensions. If standard gauges were employed alone for preparing turning mandrels, other uses of them can be neglected. Sizes will keep to gauge, indeed must do so, for all work that is turned, and this will generally govern the rest.

There is to be a contest between the makers of cut and wire nails as to the merits of each. The trials will be made by the Government officers at the Watertown Arsenal, N. Y., and will be to ascertain the holding power of the two types. Ten nails to be driven into wood, and pulled out again. There is not much doubt of the cut nails coming off victorious if made of the same, or as good material as the wire ones, and decent work in their manufacture, but as they are now sent out there is a good deal to complain of beside their holding power. There is a good proportion of scrap and sliver among the nails, and imperfect ones that cause in profanity alone, a good deal more loss than their worth in iron. The practical fact will remain that both kinds of nails are desirable in their places, and for certain uses. No report of the tests have appeared to this time.

We note that a firm of machine tool makers, in the East, have adopted a vertically adjusting tool rest, consisting of a split socket on a swivelling plate, with a loose stem in the socket that can be raised or lowered by a screw at the side, and then clamped by a bolt. This is the most simple form possible, and is also the best when made with proper proportions, but previous designs were so lacking in size and rigidity that a host of ingenious "traps" have been invented and "gone out." In the present case the diameter of the stem is about five times the width of the tool shank, and might be more with advantage. For tools of $\frac{3}{4} \times 1\frac{1}{2}$ section, the post, or stem, should be four and a half to five inches diameter, and when so made there is no need of patent tool elevating appliances, and there is little need of any when tools are made with an uniform angle, and the cutting bits held in a shank, or stem, as is common now-a-days.

It is a fair assumption that if one fiftieth part of the lore that has been written on "Technical Training," during four years past, had been devoted to "Apprenticeship," it would have done a great deal more good. Here is a subject lying at the bottom of, and is,

indeed, the foundation of all training; one without rules, and respecting which people need information, and would gladly welcome it. The redundancy of "technical training" in trade and technical journals is proof, at once, that the whole mass is nearly useless, because almost any one can construct an essay on the subject. Most of those so writing have never had anything to do with a works, or the practical conduct of industries such as are the subject of this "training." The next and inevitable step is apprenticeship, if in that term we include any kind of arrangement for learning, and nothing is more needed just now than some general rule, or, at least, information respecting the conditions of such learning. The other branch has become oppressive and useless in so far as its discussion.

Mr. Arthur Maginnis, the statistician, he may be called, of the transatlantic service, says that in a year ending last October there were only seven breakdowns of steamers at sea, and only three serious ones out of 1,900 sailings. Putting this into miles and dividing by the seven breakdowns, it gives over 800,000 miles for each. It would be interesting to know how the "war marine" compares with this. As no statistics are at hand a safe way would be to cut off two ciphers on the right, perhaps a good part of another one might go, but at any rate comparison is out of the question. It is not sufficient explanation to set up the difference of service. That is a good deal, as all know, but not enough. The method of contracting, workmanship, and management at sea, has to do with the numerous failures of war ship engines in all countries, but the main cause is a disregard of experience wrought out in the merchant marine.

In a recent discussion of topical subjects by the Mechanical Engineers, machine shop floors were taken up and several forms of them described, all of wood with a proper support beneath. Professor Sweet, of the Straight Line Engine Company, as usual contributed a new idea of applying broken stone filling with the larger pieces on top, so they could not filter down through. Our mention of the matter is to say that the Smith Machine Company, near Mount Holly, New Jersey, about ten years ago, made a cast-iron floor that had some remarkable features. It was formed of cross-hacked plates about two feet square, laid on mortar. The main objection urged, that it would be cold in winter, turned out just

the opposite. The plates kept the temperature of the earth beneath, and the shop was much warmer in winter than the others. The same cause kept it cool in summer, but the main feature was that the floor when it became smooth enabled a machine of almost any weight to be slid about as though it were on ice, which was a great convenience in handling. So far as known, the floor has proved a complete success.

LOCAL NOTES.

We happened on a neat and ingenious expedient recently. The cylinder of a large printing press, mounted on cast-iron gudgeons, following the laws that govern that metal, broke loose from its moorings and dropped down on the bed. Mr. W. A. Doble, the manager of the A. Doble Company, was called in to see the press, and instead of wrecking it to get at the cylinder, he sent up from the works an angle plate to be bolted to the side of the press frame, the tail stock of a small lathe to be set on the angle plate, placed the projecting boss of the cylinder in an improvised steady rest, started the press, drilled out and bored the head to receive a steel gudgeon. The whole operation, including the new gudgeon, cost less than it would to have taken the cylinder out of the press, besides the work was absolutely true, and better done than if the cylinder had been removed for the purpose. The cast-iron gudgeon does not admit of comment.

The brewers of this Coast have been important patrons of our engineering works here, in San Francisco, in the way of refrigerating apparatus, a branch of work that has been very successfully carried out. The Vulcan Iron Works are now constructing, for a brewing company in Portland, Oregon, one of their horizontal machines of 35 tons capacity, the engine being of the Corliss type, and the whole outfit of the highest class. The wonder is that such a contract could be secured here in view of the fact that Portland has always been an "importing" place that gave but little patronage to industries of this Coast, not because of prejudice, but because of credit. By the importing system credits fall on eastern instead of local banks and money lenders. The same rule, and the same cause, is at work in Southern California, and has been the most powerful among causes that have operated against local industries.

The promotion, to full rank, of U. S. Naval Constructor A. H. Stahl, places him in charge as chief inspector of the government work now being carried out at the Union Iron Works, in this City. The duties of a naval constructor, at this day, are of a character demanding a much wider knowledge of various scientific and technical subjects than formerly, and the Bureau is one that will require a good deal of effort on the part of the Naval Department to maintain. The substitution of wood by iron and steel for one thing, changed wholly, or, as we may say, augmented the qualifications required in naval construction, demanding a wide range of engineering knowledge, as well as what is in the abstract considered as naval construction. Constructor Stahl's qualifications more than cover the field, and the present assignment, to full rank, is only a formality, because he has been practically acting in that grade for some time past.

Egbert Judson, who died in this City last month, has, no doubt, had more to do with the industries of this City than any man who ever lived and labored here. He was interested in, and, indeed, the actual founder of at least a dozen different enterprises that, with but a few exceptions, succeeded, and in many cases have added immensely to the welfare of the community. While not recognized as a science or even a profession, one of the most intricate problems that exists is the possibilities of successful manufacture. It involves a consideration of natural resources, possible consumption, the characteristics of people to be employed, transportation, risks of changing prices, and heavy risks of capital. It was in this field Mr. Judson's capabilities were conspicuous, and most wonderful of all was the guarding and successful use of capital in various enterprises founded on his ideas alone. He is principally known in connection with the manufacture of high explosives, but was interested in chemical, paper, and pulp works, also banking and iron manufacture. He was over 80 years old at the time of his death.

One is puzzled to know on what grounds the merchants and others of San Francisco are congratulating themselves on the fact that the Panama Railway Company is to issue through bills of freight for a new company called the North American Navigation Company, and will cease to do so for the Pacific Mail Steamship Company. This last is not strange, in as much as the Pacific Mail Company is subsidized for not carrying freight, and perhaps does

not divide the subsidy fairly with the Isthmus Railway, but the problem is, why the new company should be any better than the old one. No one seems to think of the railway giving through rates to all companies, which is the natural and fair solution of the matter. Combines, collusions, and exclusive contracts, have become such a rule of our day that people seem to have lost sight of anything tending to equal chances and competition. The new Mexican line, it is reported, will not discriminate between different companies or steamship lines, and if so, will deserve the business that now crosses the Isthmus.

It is reported that the Southern Pacific Company propose concentrating at Ogden, Utah, a considerable portion of their repair and maintenance plant, which will be a furtherance to the growth of that city, obvious enough for some years past. There are various local advantages at Ogden that only await the farther development of the vast country that will become tributary to trading and manufacturing there in the near future, and investments in Ogden can hardly fail to be remunerative. The trend of business for the great Salt Lake basin will not be hard to turn to Ogden, if facilities and resources are provided there.

Locomotive Engineering is, perhaps, the most remarkable example of journal enterprise ever seen in this country. It was acquired about two years ago by Messrs. Angus Sinclair and John A. Hill, both practical locomotive engineers and railway men, who understood precisely what was wanted in the wide field to which the journal is addressed, and the result is an issue of 25,000 copies for last month, or, as the publishers say, in technical parlance "more than five tons." The principal fact about a railway is its mechanical and constructive maintenance. The pools, rates, stock, debentures, grades, climate, gauge, and even commercial conduct, can avail nothing if the motive power and running departments are not kept up. The working expenses depend on how many times the trains try to pass each other on a single track, or on the capacity of the engineering and mechanical corps. To these the journal is addressed, and its influence is an economic fact of great importance in this country.

Mr. J. W. Harrison, coal and metal broker of this City, has issued his yearly report of the importations of coal and iron at this port for 1892, from which we take the following: The total amount

of coal imported in 1892 was 1,593,850 tons from the following sources; British Columbia, 554,600 tons; Australia, 314,280 tons; Eastern States, 35,720 tons; Great Britain, 235,500 tons; Franklin Green and Cedar Rivers, 164,930 tons; Carbon Hill and South Prairie, 218,390 tons; Mt. Diablo and Coos Bay, 66,150 tons; Japan, etc., 4,220 tons. This is 108,983 tons less than was imported last year. Prices have varied for cargoes of imported coal between $6 and $7 per ton. More than one third of the whole supply was drawn from British Columbia, and the next largest from Australia, the two making up nearly 55 per cent. The importation of pig iron was only 7,347 tons against 10,783 tons in 1891. Scrap iron, 11,113 tons against 21,885 tons in 1891. Coke, 21,172 tons against 40,974 tons in 1891. These figures indicate a wonderful shrinkage in important branches of local industry. Mr. Harrison says he anticipates more prosperous trade in these staples during the coming year.

What is called the water-front decision, of the United States Supreme Court, at Chicago, promises to call up a question that has lain dormant too long in this country, the power of officers holding places by the virtue of political exigencies in disposing of public or State property. It will reinstate the City of Oakland in her possession and control of the water front there, and if followed out to conclusion will have something to do with franchises and other concessions and conveyances that effect public property. One of these is the granting of an "exclusive" right to the use of streets in cities for any purpose whatever. A privilege of use, and an exclusive right of use, are very different things in nature, if not in fact. The essence of the decision, above referred to, is that the State cannot, in the interest of private parties, abdicate its trust over property in which the whole people are interested. By State is meant its Legislative and Executive officers.

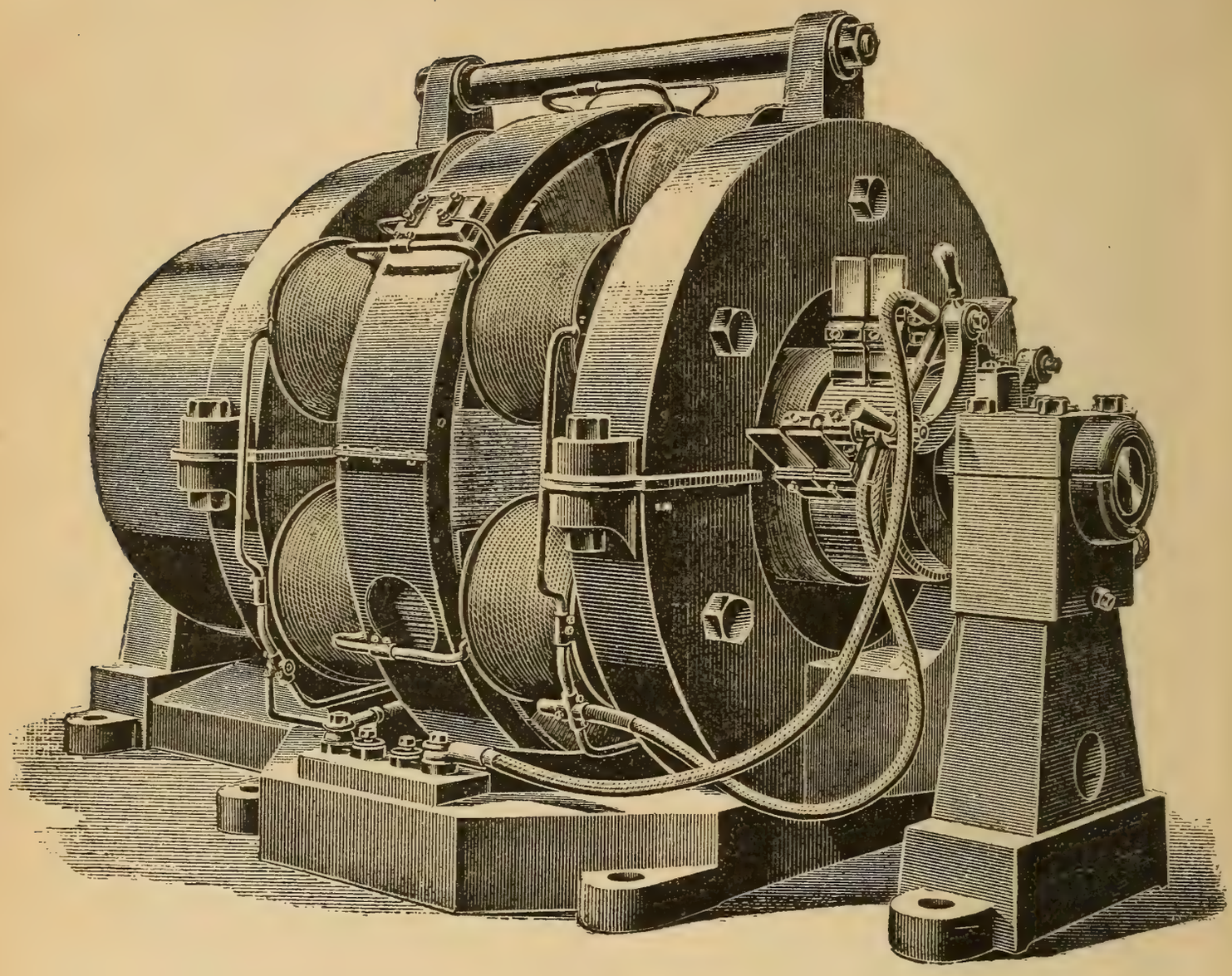
ELECTRICITY.

NOTES.

The *Street Railway Journal*, for December, published drawings of the Siemens & Halske electric conduit for street railways, and the main points of this, almost the only successful underground method to this time, seems little more than completeness, stability and good workmanship. The conductor is only an angle bar insulated in a very careful and effectual manner. For the rest there is strong analogy to a cable conduit and grip. One thing, not plain, is how contact of the grip shank, or trolley bar and conducting wire is avoided in the slot. Unless the permanent way is made and maintained with a good deal of care, the trolley shank will be trailing or rubbing at the sides. There is to be an attempt at introducing the system in this country, but as the expense will be much the same, we think that in most cases a cable will be preferred. The utilization of the gravity of down traffic, or, as we may say, the elimination of grades is a strong point in favor of the cable system.

An electrical furnace recently invented, in France, is thus described in the *Engineer*, London :

"The furnace consists of two bricks of quicklime, one upon the other, the lower one of which is provided with a longitudinal groove, which carries the two electrodes, and between them is a small cavity, serving as crucible, which contains a layer of several centimeters of the substance to be experimented upon. The latter may also be contained in a small carbon crucible. The highest temperature worked with was 3,000 degrees C., produced by a current of 450 ampéres and 70 volts, consuming 50-horse power. In the neighborhood of 2,500 degrees, lime, strontia, and magnesia crystallised in a few minutes. At 3,000 degrees the quicklime composing the furnace began to run like water. At the same temperature the carbon rapidly reduced the oxide of calcium to the metallic state. The oxide of nickel, cobalt, manganese, and chromium were reduced in a few seconds at 2,500 degrees, and a button of uranium, weighing 120 gr., was obtained from the oxide in ten minutes at 3,000 degrees.



FRENCH DISC DYNAMO.

M. HENRION, NANCY, FRANCE.

The above dynamo, which we reproduce from a drawing in *Industries*, London, shows a compact form of dynamo having three pairs of parallel circuits and two brushes, although four or six may be employed. The pole frame is divided at the center so the armature can be lifted out vertically, and the whole seems a well worked out design in a much plainer form than is common in France. The bearings have tumbling rings for lubrication, drilled full of holes so as to lift more oil, but this we think is not necessary, because any kind of ring will raise as much oil as is required.

The drawing seems at fault in respect to the junction of the outboard pedestal with the main frame, as these are, no doubt, integrally made.

MINING.

THE BENDIGO MINES, AUSTRALIA.

Mr. J. F. Marks, the editor of the *Australian Mining Standard* has contributed to the *Engineering Magazine*, for December, a history and description of the Bendigo mines, that will be of interest to people in this country.

He places the total product of gold in Australia at $1,750,000,000, of which the Bendigo mines have furnished $315,000,000, and that the present output of gold in Australia is $40,000,000 a year. Bendigo is only 100 miles from Melbourne, and must have been, for forty years past, an important factor in building up that city.

The history of the discovery and early working of these mines is of the common, romantic kind. Two colored men were the first discoverers of gold, in 1853. They sold out to a man who, in six years, cleared $1,215,000 out of the claims on Victoria Hill.

There were, at first, placer workings, pockets and the usual development down to quartz. There were "booms," of course, one between 1871 and 1873, producing, as usual, or, as we may say the inevitable, depression and losses. Another occurred in 1884, but less pronounced and less harmful.

There are at Bendigo twenty-four shafts 2,000 feet or more in depth, one of them 2,850 feet deep, with cross cuts or drifts at the 2,800-feet level. New ledges are being discovered at shallow depths, but there is no clearly defined lode as at Virginia, or the mother lode in California.

Photographic views of the city of Bendigo show it to be a remarkably well built place, with fine public and private buildings, but the main part of the wealth of Bendigo went to Melbourne. A Mr. Watson, of the latter named city, took out twenty tons of gold from the Kentish mine, at Bendigo, all of which was laid out in the Capitol.

This powerful support of Melbourne was hinted at in our last issue, and its spasmodic nature, no doubt, to some extent accounts for the present depressed state of business there — a case of over stimulation.

The government of New South Wales, Australia, has undertaken to make free assays of mineral ores, and the *Mining Standard* remarks that this will be a matter of "injustice to those who are

trying to eke out a living by making assays for the public." This is one view of the matter. Another would be that mine owners and others requiring assays would be benefited accordingly, and these constitute a much more numerous class of community. Farther, it may be inquired, whether the motive is to cheapen assays, or to guard against false work on the part of private assayers. If the latter, the economic argument fails. We do not, however, find fault with the *Standard*, or any other authority that will stand up against a dangerous "paternalism" that has been growing up in Australia, and which gives promise of Jesse Collins' formula, or the one imputed to him, that the government should furnish every man with three acres of land and a cow.

THE TECHNICAL SOCIETY OF THE PACIFIC COAST.

This Association held their regular monthly meeting on Jan. 6th, at their rooms, 815 Market Street, in this City.

The following new members were balloted for, and elected:

For members:

Augustus Knudsen, Civil Engineer.....San Francisco, Cal.
Hermann Barth, Architect.....San Francisco, Cal.
Joseph Lees Maude, Civil Engineer.....Riverside, Cal.

For juniors:

E. K. Hopkins, Hydraulic Engineer.....Ross Valley, Cal.

Six propositions for membership were received and referred.

Mr. R. E. Bush read a paper entitled "Railway Entrances to San Francisco," which is reprinted in the present number.

The Annual Meeting of the Society was held on the 20th of January, at which the reports of the officers were presented, and the following new officers were elected for the ensuing year:

President, C. E. Grunsky. Vice-President, Charles D. Marx.
Secretary, Otto von Geldern. Treasurer, Geo. F Schild.

DIRECTORS:

Geo. W. Dickie. John Hays Hammond. Louis Falkenau.
Frank Soulé. William F. C. Hasson.

The Society enters upon a new year with the advantage of a judicious selection of able officers to perform the excutive and administrative duties, an increasing membership, prestige, and a good financial standing, as will appear in next months's Proceedings, when the reports of the Secretary and Treasurer will be published.

"LIBERTE, EGALITE, FRATERNITE."

France, one hundred years ago, set up, in a reign of terror and blood, principles of political liberty that spread as leaven over the civilized world. It was a grievous and terrible contribution, the culmination of wrongs against human equality, based on the privileges of birth and accident. Now she has another task in removing a second infraction of the laws of human equality, set up by rascality, and is not alone, in her suffering from such wrongs.

The first movement of any importance there toward the inequality of human conditions, since the revolution, grew out of a method of revenue that took one man's bread and gave it to another. The motto chiseled in the stones all over Paris in 1872, "*Liberte, Egalite, Fraternite*," was forgotten, when imposts and subsidies were instituted under a plea of paying five millards of indemnity to the German Power, not that these invidious and insidious methods were in themselves so bad, but it lowered the government beneath the people of France, and set up a precedent of dishonesty that has pervaded everything, all departments, and now has brought the Republican Government itself to shame.

We are using plain but honest words, in contending that no nation which permits its government to infract personal rights, and interfere with the commercial and industrial liberty of its people, can hope for any other issue than such corruption in the end. It is true of all countries, and in the same degree that the equality and personal rights of the people are disregarded. The danger is not in France alone, and her example will be watched with interest all over the world. If her laws and procedure are not strong enough to punish commercial crime, where is the world to look for reform?

The dispatches from Paris show that twelve million francs were sent to this country as a bribe to secure coöperation in the canal scheme, and, so far as it appears, no one here is sufficiently impressed with the enormity of this thing to inquire who got the money! Our mouths are closed. The pernicious spirit of inequality has wormed its way into our institutions, as it has in France, so that this sequestration and theft of the Panama Canal funds looks like an ordinary business proceeding.

This is a severe charge, but those who think it extreme have only to remember, some months back, when the U. S. Government,

through its accredited agents, paid in this City half a million dollars more than a piece of land was worth, on which to build a post office. It is a common opinion throughout the community that one half of this money was stolen. This circumstance is almost forgotten already, and the question arises, what fault can be found with people who only imitate the acts of the great source to which we look for protection in personal rights and the enforcement of laws to equalize privileges and conditions among the people?

France is late in learning the lesson of official corruption, and will, no doubt, be the first country to cast out this terrible treachery against community. She may again, as one hundred years ago, pay the penalty of a reform to be shared by other nations, establishing a commercial and industrial rectitude now sadly wanting all over the world, and which, if not soon forthcoming, will need drastic remedies.

Anyone who has carefully considered the nature and tendencies of our time, especially during twenty years past, must see a retrogression in the honesty of our political methods commensurate with the progress made in science, industry and commerce, or in other words, but the same thing, a growing disregard of personal rights and personal liberty. Common honesty is no more than a respect for the rights of others, it is all a problem resting on the motto of: *Liberte*, *Egalite*, *Fraternite* — the tyranny of unequal laws, whether such laws relate to voting, working, or trading, is quite the same.

The laws of France, severe as they are, and carefully drawn, with centuries of experience behind them, for a people less changed and as homogeneous as any in the world, have not availed against the machinations of public men. A great engineer absorbed 33,000,000 francs of the canal fund, casting a disgrace upon a profession that has been singularly free from such breaches of trust. Members of various departments, up even to the chief executive officers, come in for a share of suspicion and distrust.

In the catch phrase of the day, "where are we at" in this matter of subsidies, bounties, concessions and personal privileges of one kind or another?

THE "MONTEREY" TRIALS.

In respect to the late trials of the Coast Defense vessel *Monterey*, constructed by the Union Iron Works, the conditions of the test were of so extraordinary a character as to preclude comment.

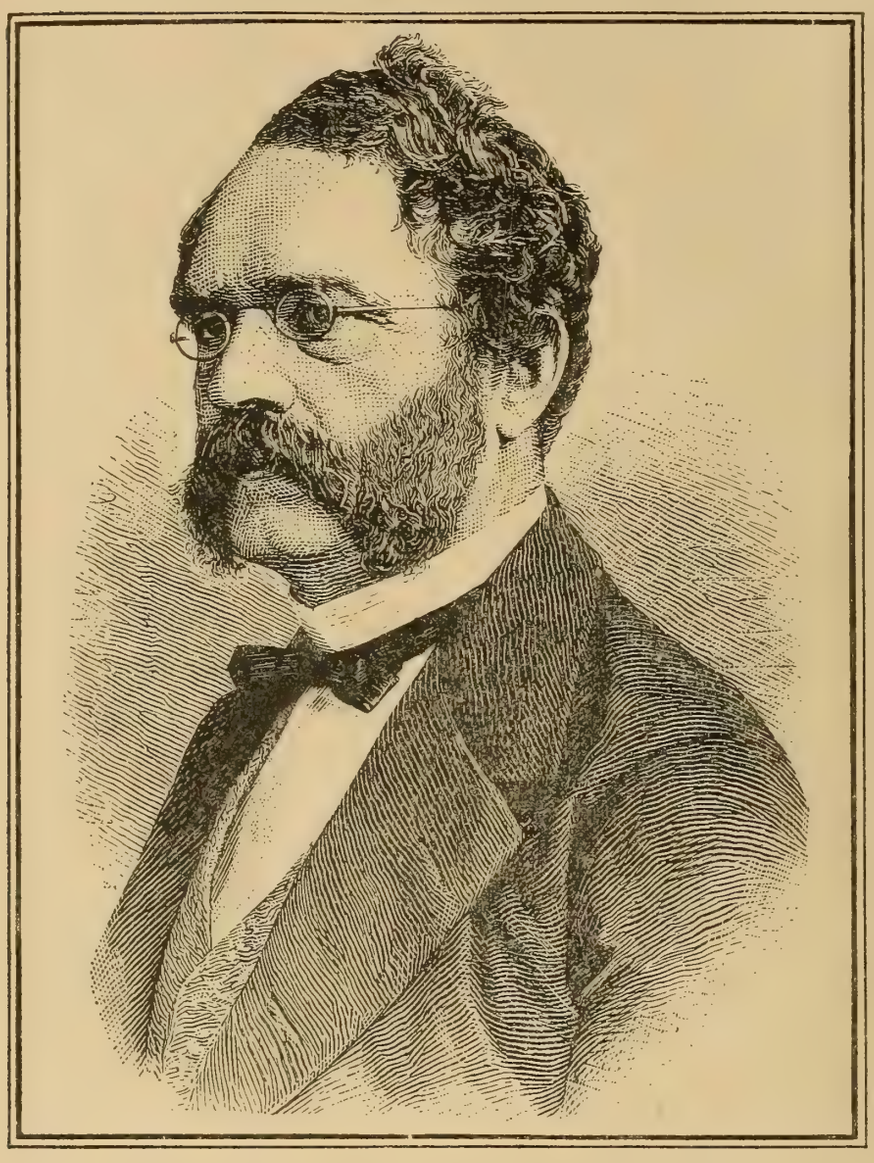
The requirements were for a stipulated horse power of the machinery, with a premium of $100 for each horse power in excess, and a fine of a similar amount for each horse power less. This far all is plain, but a part of the elements for producing this power was furnished by the government, and at the time of the contract was not determined upon, or even designed, so the contractors are called upon to guarantee the performance of what they did not furnish, control, or even examine.

The test was made with air pressure, in the stoke room, equal to 5 inches of water, but the result was more than 300 horse power short of the expected amount, involving a fine of over $30,000, owing, as we understand, to the performance of the coil boilers, provided by the government.

The Scotch boilers, furnished by the Union Iron Works, evaporated the computed amount of water, and the machinery performed in a very satisfactory manner, but, as before said, the aggregated result was six per cent. or so less than the contract calls for, through no fault of the Union Iron Works, but for which they are responsible.

The inference is that a good deal is to be learned respecting coil boilers, both in construction and working. Their use is not new. A number of war vessels in the French Navy, as well as torpedo boats in all countries, have been fitted up with such boilers. Two of the finest steamers ever constructed for lake service, in this country, are to have boilers of water tube type, but there seems to be this far something lacking in the present case.

As to the low freeboard, and water coming over the foredeck of the vessel, that was understood and expected. The vessel is a coast defense one, and not for cruising or racing, farther than to hurry to, or away from points near to each other, and the chances are that the *Monterey* may serve out her career without ever requiring other power than her Scotch boilers will generate, and without water coming over her gunwales. The *Monterey* is 261 feet long, 59 feet beam, draught 14 feet, 6 inches. Her armor amidship is 13 inches thick. She will have a heavy armament of two 12-inch rifles, two 10-inch rifles; six 6-pound rapid fire guns, and four Hotchkiss revolving guns, and two 1-pound rifles.



DR. WERNER VON SIEMENS.

The death of Dr. Siemens, on the 6th of December last, removed from the field of physical science one of the most eminent men of our age. The following brief account of his life and works we reprint from *Industries*, London :

"Dr. Werner von Siemens was one of the founders of the well-known firm of Messrs. Siemens & Halske, of Berlin. He was born at Lenthe, in Hanover, in 1816, and was consequently seventy-six years of age at the time of his death. After being educated at the Lübeck Gymnasium, he went through his military service, but while holding his appointment in the army he applied himself with great zeal to the study of practical chemistry and physical sciences, and had an opportunity of attending the lectures of Ohm, Erdmann and Magnus. He began his own scientific investigations in Magde-

burg in 1839, where he was serving as an officer. He then invented the process of electro-gilding, and the electric automatic recording telegraph, for which patents were granted him in Prussia. A few years later he brought out an important invention for the improvement of gun cotton. Being appointed a member of the Commission of the Prussian General Staff for the introduction of the electric telegraph system in place of optical telegraphs, Dr. Siemens then devoted himself specially to investigations in this field. At that time his brother William, who was in England, sent him a piece of gutta-percha, which had been brought to England for the first time. Dr. Werner Siemens at once recognized the value of the material for insulating purposes, and in 1847 he proposed the application of subterranean conductors insulated by gutta-percha, and executed successfully experimental lines coated with gutta-percha by means of a machine invented by him for that purpose, which is still used in the manufacture of cables. With the help of these gutta-percha covered wires he succeeded in laying, together with Professor Himly, the first submarine mines with electric ignition in the spring of 1848, for the protection of the harbor of Kiel from the Danish fleet. In the same year he carried out the first great telegraph line in Germany between Berlin and Frankfort-on-the-Main, and in the following year the subterranean line between Berlin and Cologne.

Dr. Siemens left the Government service in 1850, and devoted himself afterwards entirely to scientific studies and private enterprises. In 1847 he had already laid the foundation of the telegraph works carried on afterwards under the title of Messrs. Siemens & Halske, in Berlin. For a time this firm monopolized the laying of cables in Europe, and the first submarine cables between Europe and America were also Siemens' work. The world-wide reputation of the firm, acquired within a short time, led to the establishment of branch works in London and St. Petersburg, which soon developed into entirely independent large concerns.

Dr. Siemens' personal achievements are to be found in the fields of science as well as in those of technical industries. His scientific merits induced the University of Berlin to confer on him the degree of Ph.D. in 1874; they opened likewise for him the doors of the Academy of Sciences in Berlin in 1874, and subsequently of many other academies and societies. Amongst his many and various achievements in matters relating to science and technical arts must be mentioned the development of methods for testing underground and submarine cables, and determining the position of faults in them; of the Siemens dynamo, and the Siemens alcoholometer for registering the quantity of absolute alcohol contained in any alcoholic liquid. Dr. Siemens was also the inventor of the pneumatic tube system.

He was a member of most of the European electrical and scientific societies. In 1886 Dr. Siemens presented a sum of £25,000 to the German nation for the foundation of a national scientific and

technical institution. The accompanying illustration gives a portrait of the illustrious engineer taken a few years ago, when he was in the prime of a brilliant old age."

Among other tributes to the memory of Dr. Siemens we think the following from the *Electrical Review*, New York, is worthy of reproduction here :

"Jay Gould wanted a cable to be laid upon the bed of the Atlantic Ocean. With this in view he telegraphed to the agent of the celebrated firm of Siemens & Halske, in this city, saying he wished to see him.. The agent very promptly presented himself at Mr. Gould's office and was requested to be seated. Awed in the presence of the great little man, he obeyed. Suddenly Mr. Gould turned toward the agent and said :

'You are the agent of Siemens & Halske, of Berlin ? I want a cable laid across the Atlantic Ocean, and I want Siemens & Halske to make it. Have it ready as soon as possible, please.'

When the agent had recovered from the shock, he managed to find breath to say.

'Very well, Mr. Gould, we will be pleased to take your order. I will cable to the firm and have the plans ready for you in a short time.'

Mr. Gould turned his little, bright eyes on the agent and said :

'My dear man, I didn't ask for any plans. What I want is a cable. Oh ! I see ; I beg your pardon.' Whereupon Mr. Gould pressed a button and a clerk appeared.

'Mr. B——, just write out a check for $100,000 to the order of Siemens & Halske, of Berlin, and give it to this gentleman. I suppose that will be enough to start with. Come in at the end of a week and let me know how the work is progressing. Good morning.'

At the end of a week the agent again presented himself at the office.

'Mr. Gould, our engineers would be pleased to call upon you at your earliest convenience. They are prepared to submit their figures to you.'

'My dear sir,' protested Mr. Gould. 'I told you before I didn't want any plans or figures. I know Dr. Siemens. I know the firm of Siemens & Halske, and I am sure that whatever the Doctor undertakes he does thoroughly and to the best of his ability. I don't care about the price, go ahead and make the cable and bring the bill to me. But, perhaps,'—and again did Mr. Gould push the button, and again was a check for $100,000, payable to the order of Siemens & Halske, put into the hands of the astonished agent.

In quick time the cable was finished and laid, and is at the present day one of the best and most serviceable under the Atlantic Ocean.

Such was the handsome tribute paid to Werner Siemens by Jay Gould.

A TOPOGRAPHICAL MAP OF CALIFORNIA.

We have received a copy of the report of a joint committee of the two universities, the Academy of Sciences, the Technical Society of the Pacific Coast, and the Science Association of the University of California respecting the preparation of a topographical map of this State, conjointly with the U. S. Geological Survey. The subject is one that is, at this time, receiving a good deal of attention, and we regret that space will not permit a full reproduction of the joint committee's report, farther than a few points to be hereafter mentioned.

California is unfortunately situated in respect to surveys and maps. Not only are the areas vastly in disproportion to population, but the physical features of the country render surveys tedious and expensive, while contour lines, which are proposed, demand a larger scale than any reasonable outlay will permit.

It is proposed that the work be done jointly by the U. S. Geological Survey and the State, which is not, in all respects, a desirable feature of the scheme. It is different, of course, from "Government partnerships," where personal interests may creep in and, in so far as the work itself, will be entrusted to a class of professional men who have had little or no part in abuses that have attended on similar arrangements in other cases. There are, besides, the reasons before mentioned, why this State should, if possible, receive aid in what must at best be an expensive undertaking.

There is a unanimity of opinion respecting the value and importance of such a map, but much divergence in the views respecting the scale. Contour lines, which are proposed, demand a large scale, but this is impracticable, because of the cost. The committee recommend a scale of one inch to a mile, and each sheet to cover a quarter of a degree or fifteen miles square, which if confined to what is called arable areas, will require from one hundred and fifty to two hundred sheets, the cost of which is estimated at $3,000 per sheet, or roundly, half a million dollars for the whole work. This would call for the sum of $250,000 to be furnished by the State, and an appropriation of $25,000 a year for a period of ten years, which is the time the committee thinks would be required for the work.

While this joint method of preparing maps has been successfully carried out in some other States by arrangement with the Treasury Department, it should, if gone into, be done under an Act of Con-

gress. The Geological Survey is dependent upon appropriations that may at any time be withheld, and to enter upon an arrangement with that Bureau, to cover a period of ten years, and involve the sum of $500,000, and perhaps a good deal more, seems a very uncertain kind of business.

THE BUREAU OF STEAM ENGINEERING.

REPORT FOR 1892.

Chief Engineer Geo. W. Melville is as successful in reports as he is in the discharge of his technical duties. The present one is short, terse, and as full of business as a log book.

Its most salient feature is the presentation again, in still more forcible terms, the fact that there is no adequate force in the engineer service to take care of the working of our war vessels. It borders on the humiliating to see, year after year, this fact set up in unmistakable terms, and no provision made for its correction.

In other departments of public service there is a disposition to crowd them by the creation of offices, but engineers not being politicians and law makers, this department forms a marked exception to the rule. It is in its real nature the old story of emulation and prejudice between the "line and the staff," thus graphically described in Chief Engineer Melville's present report:

"The only opposition to this bill thus far has come from some of the officers of the Navy who seem to view with jealous distrust the growing importance of the engineering branch of the service and see in it an imaginary menace to the supremacy of the positions which they have inherited from naval conditions now obsolete. The plain fact is that the era of the sailing frigate with lofty spars and snowy canvas has forever passed away, and with the passing of the frigate must occur also the disappearance of much of the picturesque personnel which served its purpose in its own time, but which is now out of place on the sea except in its romances. Naval gentlemen, who resent the intrusion of the steam engine and its attendants, are doubtless sincere in their convictions, and really believe that the *Constitution* is the proper type of fighting ship and that the *New York* is not, but they draw upon the traditions of the past for their propositions, and overlook the living facts of the present. The stage driver did not yield his place to the locomotive driver until a vast amount of prejudice and conservatism had been overcome by the logic of facts, and our navy will be neither modern nor efficient until it has accepted similar relegations. The sailmakers must make way for the machinist and the boatswain for the blacksmith. The topman on a yard-arm, struggling with a weather

earing in a gale of wind, is a figure that has been almost deified in the literature of the sea, but the service he rendered to his ship, and his country never exceeded in importance the unsung deeds wrought daily in these times by the mechanic with hammer and chisel in the depths of an engine or boiler room."

The story of the *Ranger*, which, on this Coast, caused a good deal of adverse comment upon the Engineer Corps, is thus explained :

"It appears that the first day after sailing on her important mission, the only engineer officer on board was disabled by an accident which confined him to his bed, leaving the engine department to get on the best it could without a head ; matters progressed from bad to worse, as is shown by the detailed reports of the commanding officer and the court of inquiry, until the final collapse came. The whole miserable affair from beginning to end is directly chargeable to the insufficiency of numbers in the Engineer Corps, which allowed but one engineer officer to be detailed for this vessel, ordered to important duty on a distant station, where there are no facilities for making repairs, and which did not permit the chief engineer of the yard where the vessel was fitted out to have the proper number of assistants to aid him ; in fact, for some of the time he had no assistant at all."

The brick furnaces and beam engines of the *Chicago*, that have been defended by all kinds of ingenious argument, have now reached that point where the Chief Engineer says, "they have some merit," which is to be hoped. This machinery was made in defiance of the views of able engineers everywhere, and has naturally developed the precise results that were pointed out at the time of its construction. The present report says of the ship :

"The present boilers are externally fired with brick furnaces ; a type that has some merits, but whose great weight for the power developed renders its use on a modern ship of war inadmissible. The engines are compound beam engines ; a type that is also heavy, unsuitable, and out of date.

The machinery of this vessel weighs, in steaming condition, about 1,042 tons and occupies fore and aft in the ship at length of 142 feet ; the greatest horse power ever developed by it was 5,248 and the speed of the vessel slightly over 15 knots.

The machinery in one of the newer vessels of the Navy has developed 8,800 horse power on a weight of about 750 tons in steaming condition and a space fore and aft in the ship of 130 feet ; in other words, nearly 70 per cent. more power than the *Chicago*, on more than 25 per cent. less weight, and a space occupied fore and aft less by 12 feet. Similar machinery to this can be fitted in the *Chicago*, and will give her an increase of speed of nearly 3 knots, as well as an increased carrying capacity of nearly 300 tons."

Following this the Chief Engineer comments, we imagine with a good deal of satisfaction, on the "weight per horse power" craze that has acted so disastrously in many cases, especially in British war vessels. We say, with satisfaction, because he has clung to a wise conservatism in proportions that has, no doubt, saved us a good deal of loss in this country, also an equal amount of reputation. On this head Chief Engineer Melville says :

"In a previous report the Bureau called attention to the dangerously low limit of weight of naval machinery approached by modern designers, the tendency being to sacrifice weight, and with it safety, for the sake of producing machinery that will on the measured mile develop more horse power per ton of weight than ever produced before. Although approaching near enough to the danger line in this matter to meet the requirements of other bureaus, this Bureau in its machinery design has not cut the weights down below that really necessary for strength and safety, as has been done in some other countries, and, as a consequence, our machinery has been subjected to some adverse criticism as being comparatively heavy. All of our machinery thus far completed, however, has successfully withstood the full-power trials and the conditions of active service, and can be relied upon in any emergency that is likely to arise, while some of the foreign navies have experienced many serious breakdowns of machinery due entirely to structural weakness inherent in the design, and not the fault of the builders."

On the subject of steel castings, which is more hopefully spoken of than last year, there is this amusing circumstance related, which is *per se*, scarcely an indication of the state of the art :

"The Bureau recently sent two designs for engine columns—one a modified form of box-girder, the other a form of I-beam — to four of the most prominent steel casting establishments in the country, asking which of the two forms was regarded as the simpler to cast. One firm reported that it could cast either without difficulty ; another said that it could cast the I-beam, but that the girder was impossible ; the third firm offered to make the girder but not the I-beam, saying that the latter was a form that no one could make, while the fourth establishment claimed that both forms were impossible to cast in steel."

No one should find fault with the Chief Engineer for conservatism and caution. The opposite qualities are plentiful enough, and have illustration in the machinery of the *Chicago*, before referred to. No one has any doubt of the bureau adopting steel castings for framing and other purposes as rapidly as it can be done consistent with the requirements in war vessels.

The appendix shows the usual routine, and a good many tabulated results which may be noticed in future.

BALL BEARINGS.

A Mr. Elliott, an American manufacturer of bicycles, has had the courage to say that ball bearings are inexpedient, not required, and inferior to parallel bearings. Mr. Elliot being himself a manufacturer of bicyles, and as most of these peculiar machines are fitted up with ball bearings, his opinions will, no doubt, attract attention and ought to.

The subject is one that has been a number of times before reverted to in INDUSTRY. It is one of much importance, because each year we have a crop of newly-invented ball and roller bearings for all kinds of purposes, produced in deference to a popular opinion that conceives of all machine resistance of whatever kind as friction.

In Morin's tables the co-efficient of friction for good bearings, well lubricated, is about .07 per cent. of the load, which multiplied into an average man's weight would give one and a half pounds or so for a bicycle wheel, supposing it to have common bearings, but it has not. These are made with extra care, provided with "quills," and lubricated with fine oil, so the friction is, perhaps, less than one pound with parallel bearings, and in the case of balls or rollers would be just as much, unless they were in perfect order.

The objections to roller bearings for machinery are numerous and formidable. Such bearings are bulky, expensive and soon wear out, in fact their maintenance at all, is possible only where hard material is employed, and where the pressure is slight, moreover they are not required, unless it be in cases where movement of the surfaces becomes destructive, and when lubrication is not possible, as in the case of grind-stone spindles or pulley blocks.

TURRET ENGINE LATHES.

The *Iron Age* begins six pages of matter describing a turret lathe in the following words:

"During the half century which has elapsed since the introduction of the engine lathe the actual process — using the term specifically — of metal turning has remained unchanged."

After nearly a page of this kind of rhetoric comes the "Conradson lathe," illustrated by fifteen figures, which is space well spent if the article direct some attention in this country to turret turning.

Of the lathe we will attempt no criticism, except that for the functions required, it contains a wonderful number of parts

and pieces that do not seem to be required in other machines of the kind, because, notwithstanding the assumption of the Conradson lathe being a new invention, it is one of common use in England and is also one of much value.

In many English shops, especially about Manchester, the work of a shop is divided into classes, one being for turret lathes, or lathes with what may be called multiple tools. This work consisting of short spindles, studs, screws, and indeed all short turned work. drawn on separate sheets and mounted on cards or boards marked for the turret lathe shop or department.

We have many a time wondered that the same system was not employed here, especially as the other or milling form of turret machines is so extensively made and used. The English machines and the lathe described in the *Iron Age* differ from the American form of such machines in the tools being mounted at one side, and not in the line of the work, leaving free use of screw-threading, cutting-off, or other tools without interfering with the turret or the tools it holds.

It is found by experience that it is expedient to set the turret tools for six pieces of one kind. For less than this it is cheaper to do the work on a slide lathe, but for a larger number of pieces there is no comparison between the turret system and common lathes, the cost of making collar studs, short spindles, or screws and the like being not more than one fourth as much.

So well known has the cost or price of turret lathe work become that there is an uniform list, to so call it, over wide districts, where the system originated, and where the principal makers of these machines are.

Some years ago we had sent out here a number of examples of turret lathe work, including steel-point screws, cheese-head and bevel-head screws, collar and plain studs, and so on. The price was astonishing, almost incredible indeed, to those who were accustomed to doing such work on common lathes.

We are not disparaging the Conradson lathe. On the contrary, drawing attention to it, but think a sliding head or tail stock, as we call it, also an independent head, not on the turret, for screw cutting, would improve the lathes.

The makers are the Gisholt Machine Co., of Madison, Wisconsin. The principal makers of turret lathes in England, are Messrs. Smith & Coventry, Gresley Iron Works, Salford.

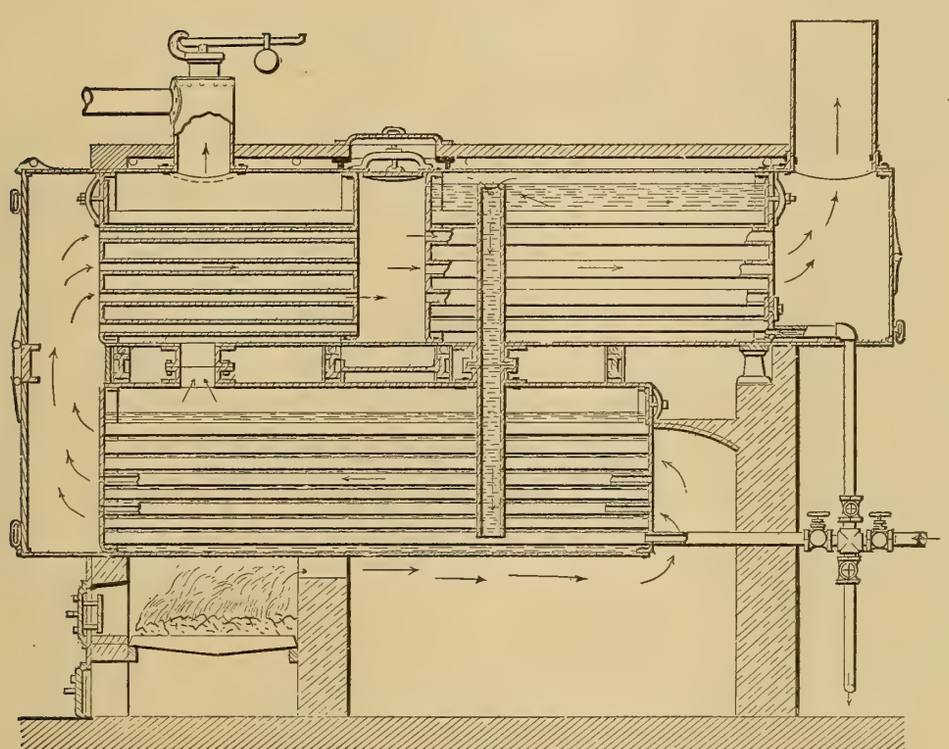
NOTES ON NEW AND PATENTED INVENTIONS.*

BY J. RICHARDS, IN CASSIER'S MAGAZINE

No. II.

U. S. Patent No. 474,385, May 10, 1892.

J. H. Hoadley.—Steam Generator.



This invention belongs to the class of boilers called progressive heating, wherein the falling temperature of the gases of combustion are adjusted to the rising temperature of the water and steam, and, as shown in the longitudinal section above, differs in many respects from present methods. The drawing being to scale, comprising nearly all the various parts, and the course of the water indicated by arrows, the whole will be understood with some study, but not perhaps at a first glance.

There has been, considering the objects to be gained, and the evident economy of the system in slow boilers, but little progress in

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this progressive method of heating, or generating steam, and in no other case have we seen the same accessibility in boilers of the class. Except in the chamber *D* there is free access to all tube plates, and even here there is no difficulty if the chamber between is made wide enough to use a hammer.

A typical progressive-heating boiler would be one composed of a series of connected compartments, the temperature of the hot gases decreasing in one direction, and the temperature of the water increasing in the opposite direction, so a diagram of the two would make a parallelogram. The feed-water would be fed in at the last compartment next the chimney, and steam would be drawn from the hottest one over the fire. There is also the principle of diffusing and breaking up the hot gases between the sections or compartments by chambers, as shown at *D* in the present boiler, and sometimes by baffling plates or walls in addition.

The idea or scheme is good. Its first application, so far as known, was in Scotland, and for marine purposes, but the references are not at hand. In this country Mr. John L. Heald, of Heald's Agricultural Works at Crockett, on Carquinez Straits, near San Francisco, has made some extensive experiments in progressive-heating boilers, the result of which we do not know. The Scotch boilers were superimposed, as in the present case. The Heald boilers were set tandem, so to call it, a series of compartments in one parallel shell, the feed-water passing from the top of one compartment to the bottom of the next one up to the last, where there was steam space provided.

One feature of such boilers is that the greater part being filled with water, and the sections independent except as to the connecting pipes, destructive explosions are hardly possible. There is also the advantage of increasing the number and area of the tube-heating surface, because all sections, except the last or steam one, can be filled with tubes. The present boiler of Mr. Hoadley's is not presented as a type of progressive-heating boilers, but as one wherein this method is present with other new features of interest to steam engineers.

In considering the efficiency of steam boilers, one of the principal factors is commonly left out — the imperfect combustion of fuel, and there is a good deal of promise at this day for efforts in that direction. It will not be extravagant to claim that boilers themselves have undergone nearly all the experiments that are likely to

improve their performance. The compromise between the material required for strength, and the barrier thus set up between the water and the hot gases, is an insuperable impediment to convection that can be met only by smaller diameters and thinner plates. This, and indeed all other features and functions of boilers, has been thoroughly studied by the learned and unlearned, without a corresponding success in economic results that can at all be compared with what has been done in dealing with the steam after it leaves the boilers.

In improved methods of burning fuel, we are met at the outset with an impediment of a discouraging nature. The fuel must rest on a support beneath it, and the gases of combustion must pass upward, away from, instead of through, the fuel. Fresh fuel must be fed to the wrong side, and its imperfectly mingled gases start off on a journey of imperfect work.

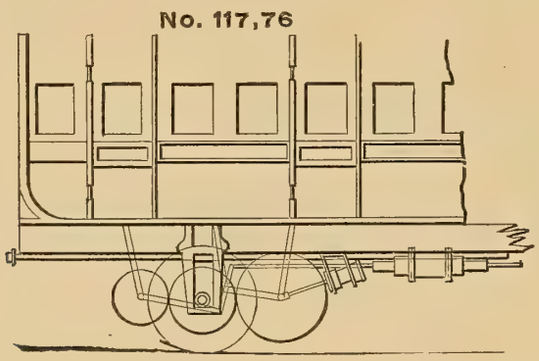
It is true we have down draught, water grates, and some degree of success in these, also in bottom feeding, burning on plates, and more. Here we imagine lies the line of the next successful effort at heat saving.

British Patent No. 11,776, 1891.

Newton.—Railway Brakes.

This patent describes an attempt to utilize the momentum of a railway train in applying brakes on the wheels, the resistance being produced by means of revolving frictional discs or wheels pressing on the wheels of the carriages, and their rotation opposed by pistons acting on air. The scheme involves a good deal of detail, and, aside from any practical merit, is an interesting study for those connected in any way with the subject of brakes, in as much as it is an attempt to avoid "sliding action," the common means of producing brake friction. The purpose in alluding to the patent is not to comment upon the merits or limitations of the method, but as a text for some remarks upon the principle involved, and to say that the failure this far to employ the momentum of trains in applying brakes seems an anomala in modern mechanical achievement. There is present a powerful force commensurate with the brake resistance required, not only force, but moving developed energy communicated to rotative parts, and available almost in the same degree as is the torque of an engine, or water-wheel shaft.

The elasticity, or variation of position, between the body of carriages and the axles and wheels on which they rest, is an impediment of more importance than would appear from inference, a matter proved by the difficulties of our time in transmitting from electric motors to the axles of railway cars, but such impediment is fast disappearing in the case of driving motors, and is certainly a much easier problem than the transmission of power from an axle to such mechanism as would be required to set railway brakes. Of course any communicating, or "throughout," system where the brake power, or setting force, must be uniform, and nearly instantaneous throughout a train, is best performed by air, and the exigencies of use are such that the economy of energy, or cost, is hardly to be considered, but there is a wide field in street lines alone, where pneumatic brakes are not employed, and where it seems that the momentum should be utilized for braking at least, if not stored as a re-starting force.



We know the theme is an old one, and its history, so far as attempts have been made, is one of complicated and impossible contrivances. There is also the fact that mechanism of any kind for such a purpose must be dragged through the streets, so to speak, covered with sand and grit, and that it must, in any case, involve a great deal more detail than simple shoes pressing against the wheels by toggle gearing, but the question arises have the limitations of the system been reached?

The storing or accumulating expedients common in mechanics are, compressed springs, compressed air, and elevated weights. Springs are liable to fracture and change of tension or resistance. Compressed gases require fits almost impossible to maintain beneath a car, and weights are out of the question, so that at the very outset there are set up discouraging conditions of a very serious kind. The patent at first cited adds a new principle, or "mode of operating."

Patent No. 472,432, April 5, 1892.

H. P. Christie.—Friction Clutch.

The invention of friction clutches has, for ten or twelve years past, gone on at a rate that would lead one to suppose the subject exhausted in a mechanical way, and that nearly all the expedients possible had been resorted to. This may be true, but the diversity is far from showing an intelligent research. One reason of this is not far to seek. Clutches have no literature to speak of, and the various modifications are produced by contriving, without certain definite ends in view.

This paucity of general information on the subject is proved by a remark made to an Eastern friend at Philadelphia some years ago, that the makers of mill gearing in the East should furnish clutch pulleys for driving dynamos, that would have no running joints when the dynamo was not in motion. The speaker was informed that "such a thing was not possible." The fact is that if a specification for clutches was drawn with this requirement, there are very few works in this or any other country that would know how to execute such an order. Still it is possible, a matter of regular practice on the Pacific Coast, and the present patent is cited to show one method of making such clutch pulleys without running joints when unclutched or free.

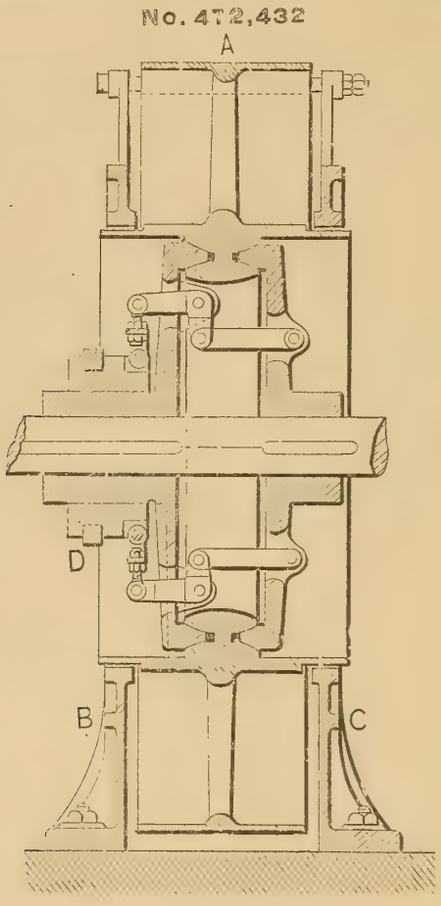
It is a common and almost universal practice to mount the pulley to be clutched, loosely on the shaft, where it rests when out of use, equivalent to a running bearing, sustaining the strain of the belt on one side, and requiring constant and careful lubrication. It is not only equivalent to a bearing for the shaft, in respect to speed, area and strain, but has not the advantage of wearing to a fit, as in the case of a journal. The shaft is worn on one side, and the fit distorted. The more the wear the worse the fit, so that, in point of care and risk, one loose pulley of the kind causes more difficulty than three common journals on the same shaft.

Referring now to the diagram, it will be seen that the pulley *A*, when not in use, does not rest on the shaft at all, but on two brackets or collars *B* and *C* that are bolted to the ceiling, or on a foundation, the same as the hangers or pedestals on which the shaft is mounted.

The pulley has an enlarged boss, or second rim it may be called, which takes its bearings loosely within the brackets or standards *B* and *C*.

The clutch mechanism consists of two jaw plates, one at each side, both free to slide on the shaft and the keys seen in front. These jaws or gripping plates are drawn together by bell cranks and links operated by a common toggle apparatus and sliding collar, shown at the left and understood without farther explanation.

In this manner the clamping strain is opposite and equal on the gripping faces, and the parts adjust themselves when the clutch is engaged. The stationary brackets *B* and *C* are bored out a little larger than the diameter of the hub or boss of the pulley, so that



when the jaw plates are closed and the pulley starts, it is at once moved free of its stationary supports and brought concentric with the shaft, so the adjustment of the brackets is not a matter of so much precision as might be supposed.

When the gripping plates are loosened the pulley at once takes its bearing on the brackets, and there is then no sliding or running bearing except the collar that moves the toggle joint. There is neither contact, wear, nor lubrication, and the shaft is relieved of the strain of the belt, so that no attention whatever is required when the clutch is out of use.

Previous to adopting this form of clutch pulleys, Mr. Christie employed for similar purposes telescoping pulleys, having the same functions in respect to strain, running joints and so on, but the mechanism was more expensive. In that case there was a stationary pulley, it might be called, mounted on a fixed bracket or support. Fitting closely over this fixed pulley was a movable and running one, having the edge of the rim chamfered off to an edge, so it could be shoved under the belt raising it from the fixed pulley, in other words the movable pulley took the place of the fixed one while the belt was in motion, and was slid out leaving the belt on the fixed one when out of use.

In the present invention the supplementary fixed bearings for the pulley are the main feature, and the performance in practice is very satisfactory and a great advance on any method that leaves the stress of a belt to fall on a boss or hub, bearing upon a running shaft.

In respect to clutches in general there seems to be, especially in England, a total neglect of the fact that the tractive power of frictional surfaces is as their distance from the center of rotation, or in other words, as their speed ; notwithstanding this, we see the diameter of friction clutching mechanism reduced down to the smallest dimensions and applied even around the hubs of pulleys. This has the unimportant advantage of the friction surfaces coming in contact at a lower velocity, and also reduces the size and weight of parts, or appears to do so, if the tractive force is not as it should be, estimated as the measure of capacity.

Small diameter or slow speed calls for corresponding intensity of pressure, and this causes a like wear of the faces, because slipping is unavoidable, indeed slipping is an essential function of all friction clutches, without which they would be inoperative as such, and correspond to the old positive jaw type, now nearly out of use. Present progress is also indicated by the abandonment of what may be called the non-equalizing types, wherein the force that presses the friction surfaces together was taken up on a fulcrum or abutment independent of the faces, and not "balanced" as it is called. This was commonly done by toggle struts that bore at their inner ends against the hub of a pulley or wheel, or a collar on the shaft and within the outer rim of the wheels. The subject is an extensive one and may be taken up again at a future place, pointing out now, however, that the most important and most perfect type of friction clutches and those most commonly employed are, with certain limita-

tions, "shifting belts." One seldom thinks of a shifting belt as a friction clutch, but it is nevertheless, in all essential features, and so perfect that no other device of the kind can compare with it.

The frictional surfaces in contact are commonly leather and polished iron, a combination the best that has ever been discovered. The frictional surfaces are so long or so extensive, and operate under conditions that avoid heat, which is an impediment in all other clutches, especially those of high speed, and to transmit a large amount of power. The pressure is elastic, cumulative, and increases with resistance, which is not the case with common friction clutches. The engaging force is inherent and automatic. There are no toggles, levers, or other apparatus requiring effort; the spiral winding of the belt accomplishes all except the slight force to "direct" it. Viewed in this manner it is not hard to account for the survival and almost universal use of shifting belts to stop and start machinery.

It can also be seen that friction clutches with metallic faces are frequently applied when they are not required, and when shifting belts are preferable every way, on the countershafts of lathes, for example, to reverse the motion. The reason for this is that as usually arranged, the time required to shift a belt prevents accuracy, or is not sudden enough to meet the conditions of screw cutting. This fault is easily remedied by making the belts narrower, increasing the diameter of the pulleys and increasing the speed of the belts. If, for example, a lathe belt is made only two inches wide instead of four inches, and the pulleys are two feet in diameter instead of one foot, the time of shifting or reversing is not only reduced one half, but a good deal more, because edge flexure of a belt is inversely as the square of its width.

In this last named fact we find the principal limitation of shifting belts, which confines them to a small amount of power. There is also the wide space required for double pulleys that becomes a serious impediment in most cases.

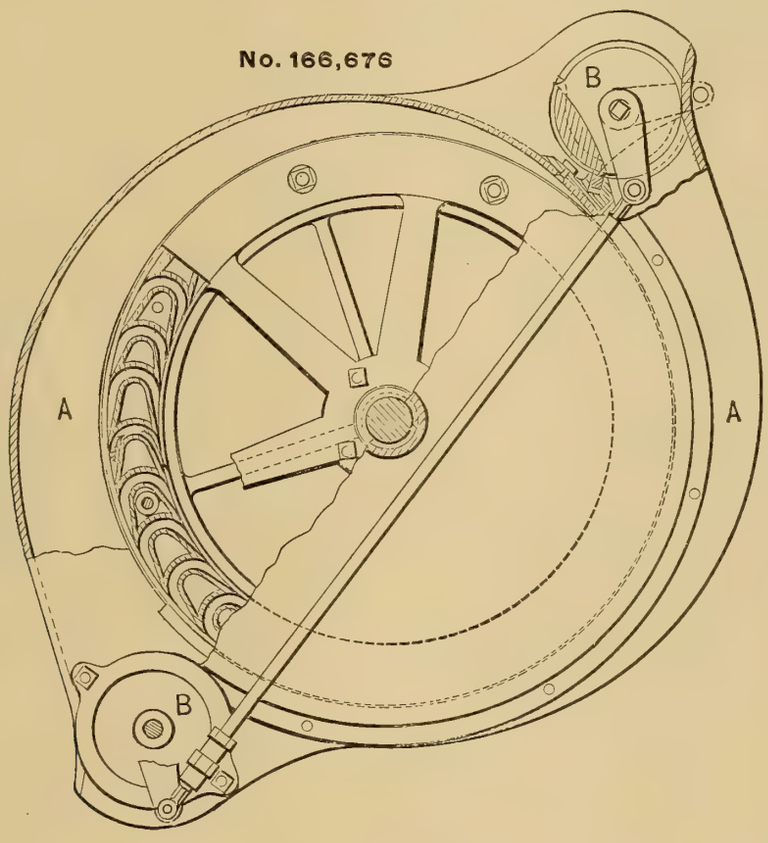
U. S. Patent No. 166,676, Aug. 10, 1875.

Atkins.—Water Wheels.

Continuing in digression from recent inventions, the present patent will form a proper subject for some remarks at this time, especially as there is much present interest in the subject of impulse water wheels. In a letter written recently to the editor of *Power*,

it is claimed that the above named patent is an anticipation of what is called the Pelton water wheel, a conclusion that there seems no warrant for, especially as an analysis of the Atkins wheel by any competent hydraulic engineer will hardly ascribe a duty of 50 per cent. to the Atkins modification. The plan diagram below gives a very clear idea of the mode of operation, *A* is a volute chute from which water is discharged to, or forced into, the reversed apertures in the rim of the wheel, and discharged inward, both inlet and discharge being as nearly tangential as possible.

In respect to a comparison with modern impulse wheels, there is found, in the words of the patent above cited, a



good deal to warrant the conclusion of the writer before named, but not enough. In the first place, impulse wheels operating on the principle of the Pelton type are not new, and antedate by at least a score of years the patent of Mr. Atkins. We do not mean "flutter" wheels, undershot ones and so on, but those in which the water was discharged by clear impinging jets against the vanes, the Girard type is one of these, and even centuries earlier were the tub impulse wheels with flat oblique vanes. The Pelton wheel is one with a straight cylindrical jet, delivered under all the conditions that will insure maximum or theoretical effect

with vanes or buckets that split the jet and reverse its course as nearly as possible tangential to the wheel's course and clear of it.

None of these conditions are fulfilled by the Atkins wheel, nor by the Girard types. The jets are not cylindrical, which is the form of greatest effect. The course of the jet is not completely reversed in the Girard, is nearly so in the Atkins wheel, but against centrifugal force, and is left tangled up in the wheel, so to speak. The efficiencies are as these conditions indicate. The Pelton wheel gives a maximum efficiency that, no doubt, exceeds all forms of previous impulse wheels, also filled or pressure turbines. Mr. R. D. O. Smith, the writer before named, whose address is not given, says that, so far as he has observed, the reason of this effiiciency has never been explained. If he were to hear a discussion on the surface resistance in nozzles of various forms, and the friction of wetted surface in the buckets, with nice distinctions of angles, by the engineers on the Pacific Coast, he would change his mind.

That portion of the patent of Mr. Atkins bearing upon open or unfilled wheels is worth quoting here as follows :

"It was stated above that the aggregate sectional area of all the channels between the buckets should be double that of the two chutes in the trunk, through which water is supplied to the wheel. In connection with the above, I will make the further statement that the velocity of the wheel, in order to obtain the maximum amount of power, or an amount equal to the whole momentum or living force of the water acting upon it, must equal one half the velocity of the water at the instant of contact with the buckets.

I will next undertake to explain why it is necessary that the aggregate sectional area of all the channels through the buckets should be equal to twice that of the chutes.

Suppose, now, that the wheel is barred so that it cannot move, and that the gates are opened ; we shall find that as the water flows through the buckets with the same velocity as in the chutes, so long as the wheel remains stationary, the water will only one half fill the water channels, the remaining one half of each channel remaining empty ; but on allowing the wheel to run with its maximum speed of half that of the water, the velocity of the water in its passage through the buckets will be only half what it was while the wheel remains stationary. Therefore its volume will be double, and consequently will exactly fill the channels, thus excluding all backwater from the wheel, which, were it allowed to be carried around with it, would, by its centrifugal force, greatly impede the passage of the water through the buckets, and thus reduce the power of the water upon the wheel."

These propositions can be understood by referring to the diagram at the beginning. The volute chutes surrounding the

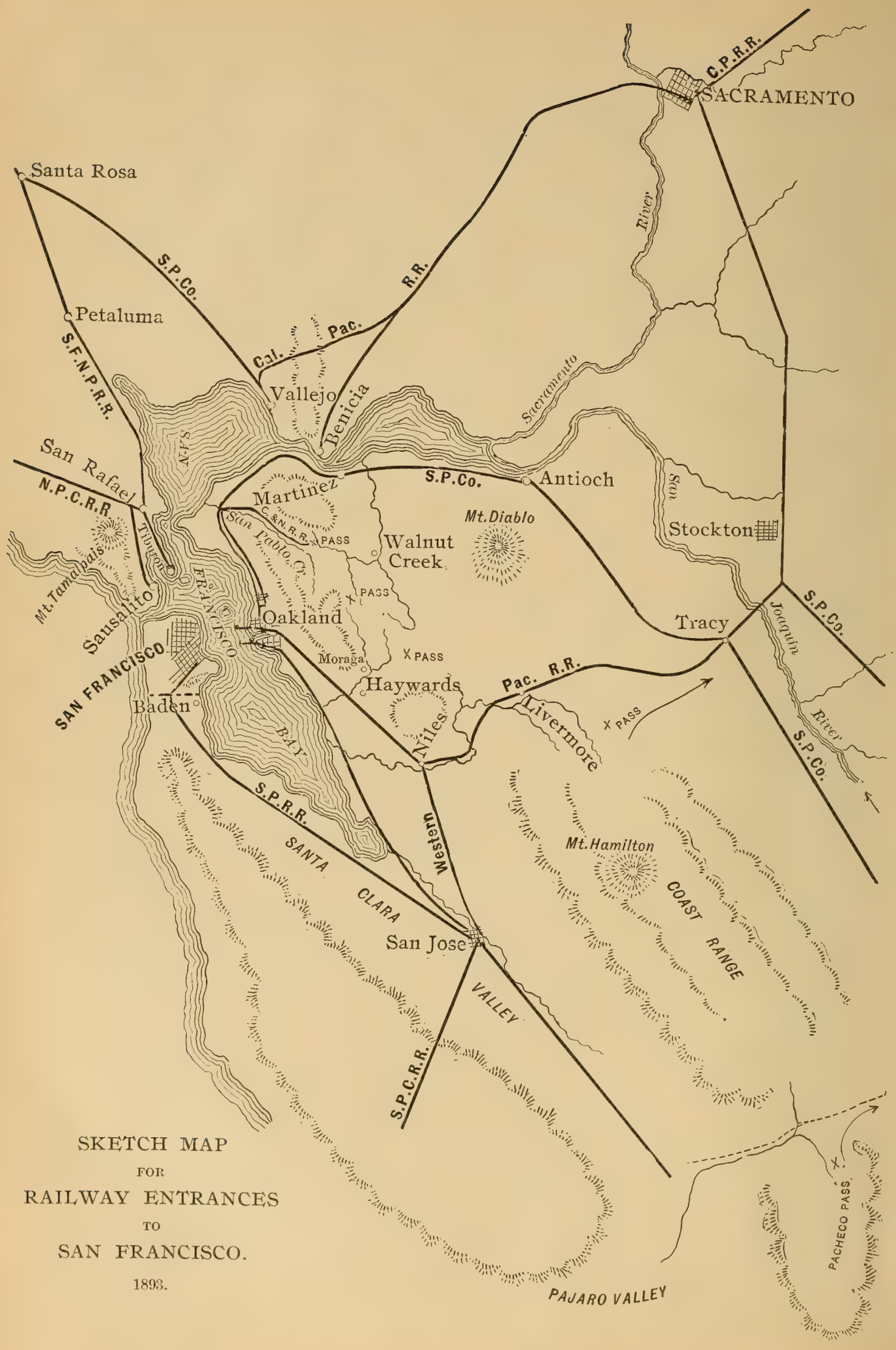
wheel, represent, in a sense, jets, indeed become so, because of the reduced sectional area proposed, and the wheel, as distinguished from a pressure turbine, is one wherein impulse takes the place of pressure, because of the contraction of the chutes. Here analogy ceases, because even in the Girard multivent chutes there is a better application of the water, but an inferior form of buckets compared to Atkins, especially if the latter opened outward instead of inward. It is a good wheel, however, comparatively speaking, for eighteen years ago, and under high heads will give a creditable efficiency. The reasoning above, in respect to the discharge through the wheel when still and when in motion, conveys or explains a principle in hydraulic motors not commonly understood, and one of a good deal of importance, applicable in other wheels.

U. S. Patent No. 475,026, May 17, 1892.

J. F. M. Woods.— Reversing Gear for Engines.

This invention is a reproduction in a much improved form of what is called a transfer plate between the face of a slide valve and its seat, so induction and eduction ports are transposed. One of its earliest recorded uses in this country was on some of the first Baldwin locomotives, at Philadelphia, where, as now remembered, it was introduced at the instance of Mr. Joseph Harrison, Jr.; at least he had in his possession, previous to his death, the patterns from which these transfer or transposing plates were cast. Perhaps an earlier use was on the cargo engines employed on the Mississippi River. The method is old, but is in the present invention produced in an improved form, these being longitudinal and transverse sections through the valve and transfer plate.

It is unfortunate that the requirements of steam distribution do not admit of economical reversing devices of the kind, or by means of changing the steam exhaust ports and the reverse, a difficulty vastly increased at this day when valve functions have become more and more an element in the economical working of steam engines. It is true the principal objection to mechanical reversing gearing is exposure and wear, which in most situations are not considerable, but in other cases a serious objection, so much so that it is better to abandon lap and lead to reverse by steam.



SKETCH MAP
FOR
RAILWAY ENTRANCES
TO
SAN FRANCISCO.
1893.

RAILWAY ENTRANCES TO SAN FRANCISCO.*

By R. E. Bush, Mem. Tech. Soc.

The water-front suit, now pending in Oakland, and the recurrence of the rumor of the coming of the Atchison, Topeka & Santa Fé Railway, makes the railway entrances to the City an interesting study.

The discussion this evening will be confined to the matter of grades over the Coast Range, leaving the financial aspect of a right of way and water-front to others.

The peninsula of San Francisco, as a seat of commerce, consists of six basins: two fronting northward, Harbor View and North Beach; and four opening eastward, namely, Mission Bay (including the Market Street region), Islais Creek, Bay View, and Visitacion Valley. These basins are separated from one another by ridges, known respectively as Black Point, Telegraph Hill, the Potrero, Hunters' Point, and Black Mountain.

South of Visitacion Valley, the San Bruno Mountain rises abruptly from the water's edge on the bay, and forms the barrier between San Francisco and the level Santa Clara Valley. The direction of growth of the business city is southward, driven there by the increasing values of Mission Bay lands.

The railroad aspect of the City divides itself into two parts — past and future.

Two local roads deliver freight on the sea wall, near Telegraph Hill, both from Marin County. The Donahue road (the San Francisco and North Pacific R. R.), operating 162 miles, runs its ferry from Tiburon. The North Pacific Coast R. R., operating 94 miles, runs its ferry from Sausalito. Both roads can avail themselves of the Harbor Commissioners' belt road, when it is completed, along the sea wall.

The Southern Pacific Company delivers its through freight at its Townsend Street station by a transfer ferry from Oakland. This station is also the City terminus of the Coast Division of the Southern Pacific R. R., whose track from San Jose enters the City at the western end of the San Bruno Mountain.

Passenger traffic of the three roads is landed at the foot of Market Street.

*Read before the Technical Society of the Pacific Coast, Jan. 6, 1892. Reprinted by permission.

Mission Bay basin will always be the commercial center of San Francisco. For this reason all competing roads must secure a good footing therein, either by track or by ferry, so as to have facilities in freight-handling equal to those of the Southern Pacific Company. This Company reaches the center of this basin now, and for future development it owns about 100 acres in the submerged lands of Mission Creek. Sixty acres of this, extending from Channel Street and Third, southward to Butte Street on the Potrero, control nearly one mile of dock space.

This strip was located under the provision of the statute (Laws 1868, p. 720) which granted thirty acres each and a right of way 200 feet wide over tide lands, to the two companies that proposed to parallel the old San Francisco and San Jose R. R. These companies, the Western Pacific R. R. and the Southern Pacific R. R., secured the grant but never built into the City.

In those days the Central Pacific ending at Sacramento, delivered its San Francisco traffic to river steamers and to the California Pacific R. R. running to Vallejo. From its land grants and subsidies, it was the dominant company in railway matters, as the Southern Pacific Company is today. That it might enter San Francisco over its own tracks, it built the Western Pacific R. R. to San Jose and to Oakland, and then purchased the Cohen Ferries from the City to Oakland and Alameda, all in 1869. One half of the grant in Mission Bay thereby belonged to the Central Pacific Company.

The other 30 acres were owned by the only serious competitor the Central Pacific R. R. ever had, namely the Southern Pacific R. R., which was organized to build east, and thereby secure the Congressional grant on the 32nd parallel.

In December, 1869, the control of the Southern Pacific R. R. passed to Central Pacific men, but its corporate form has been kept intact. In April 1870 the Southern Pacific R. R. paid $3,000,000 for the old San Francisco and San Jose R. R.

Thus the owners of the Central Pacific R. R. secured their terminal grounds in Mission Bay, and also the only track entering the City. By various transfers these all belong to the present dominant corporation — the Southern Pacific Company.

Since 1870 freight has been ferried across from Oakland rather than make the detour through San Jose to the City. The Company in after years improved upon its Livermore line by building the river line from Tracy to Oakland, via Martinez — encouraging

thereby the location of grain warehouses on deep water at Port Costa. It then unified its local lines by connecting its California Pacific track with Port Costa by means of a short spur, and the transfer ferry "Solano." Thus the three systems of the Southern Pacific Company converge at Port Costa — the Shasta line, the Ogden route, and the Sunset route.

So far then in the operations of the Company it has not been necessary to build its Bay Shore line over the 200-foot right of way from Baden to its terminal grants in Mission Bay, nor will it be necessary until by closing the San Luis Obispo gap it has a coast line to Los Angeles.

Can other companies get access to the City? Indeed, can one other company get near enough to establish a ferry? Certainly if enough money be spent in purchasing yard room, and a right of way through city property.

In fact into the City new roads must come, for here, not at Antioch, nor at Martinez, nor at Baden, nor in Oakland, but here in San Francisco is the established commercial center of California.

I assume, so far as this paper is concerned, that a new road can enter the interior valley satisfactorily. In fact, crossing of the Sierras, a range whose summit at its nearest point to us lies distant 150 miles easterly from San Francisco — I say, crossing this range is a problem by itself, and must be solved by other considerations, such as the lines of approach to the State, the necessity for snow sheds, the rate of grade required.

I assume then that the road enters and serves the terminal points in the interior, Red Bluff in the north, Sacramento and Stockton in the mid-valley, and Fresno and Bakersfield in the south. How can it reach San Francisco?

In planning for a competing road thus situated, I consider the following to be the controlling conditions for freight traffic:

1st. Enter the bay region by grades not exceeding 40 feet per mile.

2d. Locate division yards and shops on cheap lands.

3d. Secure yard room between Market and Townsend Streets, in San Francisco.

4th. Enter San Francisco by a ferry.

The bay region comprises:

1st. The Sonoma side, a narrow fringe of valley land on the northern shore, extending from near San Rafael to Vallejo.

2d. The Oakland side, a similar edging extending from Pt. Pinole southward until it opens out at Niles into the Santa Clara Valley.

3d. The Santa Clara Valley itself, the southern arm of the bay region.

This territory is well traversed by railroads, there being nine tracks therein already.

In noting the passes into this San Francisco Bay region I will begin with the southern part — the Santa Fé will probably come in that way ; and then take up the northern part—the sale of the Donahue road may introduce an eastern company ; and then discuss the more important side whose center is the city of Oakland.

The Coast Range is so lofty, and its passes so far south, that the Santa Clara Valley will be entered by those roads only that come into the State south of Yosemite.

Since the San Joaquin Valley offers more inducement to a paralleling road than the Salinas Valley, it is probable that Pacheco Pass, the northernmost one, will probably be chosen by any southern road. Pacheco Pass is a good example of the wisdom of abandoning a wagon road, and searching for a better way in untraveled country. From the forks of the San Felipe Creek the wagon road climbs five miles up a ridge on a five per cent. grade to a handy gap, and avoids the precipitous upper canyons of the South Fork. Near the head of the South Fork, which rises eight or ten miles southward from the wagon pass, the summit ridge is narrow, almost a knife edge compared to the range itself, and was made so by a similar canyon on the east, flowing northward also. By utilizing the low grade of two canyon bottoms, and tunneling a mile or more, it is possible, so I am told, to get through on a grade between 0.8 and 0.9 per cent.

Once through the pass a road would have a level run to Oakland or to Baden. At Baden the San Bruno Mountain is an obstacle. At its east end the shore line already holds the main pipe of the Spring Valley Water Works. In the tide lands off shore is the reserved right of way upon which the Bay Shore line will be built by the Southern Pacific Company. The Bay Shore line once built, a close examination of the crooked and precipitous shore may disclose a feasible line for another company.

The present track at the western end of the mountain has grades of 1.18 going north, and 1.77 going south, over a summit whose elevation is about 400 feet.

Passing now to the northern part, the two local roads, the Narrow Gauge and the Donahue, possess the two best terminals in Marin County, Sausalito and Tiburon.

Outside of local traffic considerations there are, in this section, two minor impediments for a competing road — the spur that ends precipitously at Carquinez Straits, and the spurs heading in Mount Tamalpais. The first-named spur is now crossed by the California Pacific ten miles north of the river near Suscol. East grades are from 1.3 to 1.7, west grades are 1.75, too high for a trunk road at present. The California Pacific track was built for an opposition trunk road in 1868, but soon was purchased by the Central Pacific. Its present light traffic does not warrant taking out the high grades. I do not know about other passes in the ridge particularly ; however, the city of Vallejo is now preparing to get its water supply from Green Valley on the other side of the ridge.

Were it not that the War Department occupies Army Point, the eastern end of the straits, through whose grounds the main line of the Southern Pacific now passes on its way to the transfer ferry at Benicia, the north bank of the river might be used for a level line from Suisun to Vallejo, similar to that on the opposite side at Port Costa. The local traffic of Vallejo and Benicia, and the ample space for wharves on the north side, may bring a road there yet. The detour around the spur by the river might discourage San Francisco through travel, and thus make the river line disadvantageous. The longer extent of the cliffs on the south side of the river makes it difficult to arrange for a ferry for a competing road at Vallejo, the narrow space on the south side being occupied now by a double track.

The second impediment consists of the three spurs near San Rafael. These are broad and low, and will introduce into a line much curvature or long tunnels.

The Donahue line approaches its tunnel through the San Rafael hill on grades of 1.9 north, and 1.5 south, through the Corte Madera and Tiburon ridges, it has grades of one per cent. both ways.

The line of the Narrow Gauge crosses these two ridges between Sausalito and San Rafael on grades of 79 feet per mile. The grade on the curve to San Rafael is over 80 feet to the mile.

It is likely that a competing road through the Sonoma side of the bay would buy a trackage right rather than build its own line through the ridges running out from Tamalpais.

Of all the bay region, the Oakland side is the more interesting. Here the suburban ferry travel of the City of Oakland gives the Southern Pacific Company one of its chief sources of income.

Here also the harbor improvements will accommodate deep-water ships, and the Oakland Water Front Company, a subsidiary company of the Southern Pacific Company, whose title to the whole water front of Oakland is in litigation, has lately offered to sell portions of its tide lands without restriction as to their future use.

The traffic already centering in Oakland can be handled easily by competing roads, for there are no less than three general routes through the Coast Range, back of Oakland, with five passes.

The Western Pacific Railroad, from Stockton through Niles Canyon, even in its early day found a one per cent. grade over the Altamont summit, east of Livermore. I cannot give the results of the survey once made through Corral Hollow, south of Altamont. In Niles Canyon the dam and pipe of the Spring Valley Water Works may interfere with a second track. A more direct line from Livermore runs through Crow Canyon to Haywards. If this pass requires a four per cent. grade as said, then Bollinger's canyon may lead to a better pass in the vicinity of Moraga Valley.

The second route passes to the north of Mt. Diablo, and up the San Ramon Valley to Walnut Creek. From the southerly branch of Walnut Creek there is a pass at an elevation of about 580 feet opening into Moraga Valley. I am informed, though not officially, that the survey for the Great Salt Lake road through this pass is run on a grade of 49 feet per mile between Walnut Creek and East Oakland. There is a 6,000 foot tunnel on their survey through an outlying ridge to avoid a detour to San Leandro. From the westerly branch of Walnut Creek, Charles' Hill Pass leads to the watershed of San Pablo Creek, flowing west.

The California and Nevada Railroad is already in operation from Oakland to Bryants, two miles west from this pass. Their surveys over this summit, whose elevation is about 635 feet, give grades of 1.5 going east, and 1.0 going west. This Walnut Creek route is available for roads coming from the San Joaquin, and also by transfer ferry for those coming down the Sacramento Valley.

The third route is now exclusively occupied by the Southern Pacific Company's double track from Martinez to Oakland. The abrupt hills for six miles or so on the south side of Carquinez Straits give barely room for the present road at the water's edge, and the canyons running back from the river will prevent a trunk line from being laid out at a higher elevation. This river line is the main entrance of the Southern Pacific Company's system to San Francisco.

Now, not forgetting that the level river line gives the Southern Pacific Company an immense advantage in handling freight traffic, I formulate my first condition for a competing road to be a grade a little less than the reported possibilities of the other passes, namely a grade of 40 feet per mile, or 0.75 per cent. I believe that a more thorough survey will show this grade to be possible without sacrificing first cost.

The second condition, locating division yards and shops on suburban land is self evident from a financial standpoint.

As to the third, securing freight yards between Market Street and Townsend Street, this is the part of the business center whose dock fronts are not controlled by the 60 acres granted and belonging to the Southern Pacific Company. The streets south of Market Street, too, as contrasted with those north of Market Street, are broad, and run almost level for long distances, facilitating truckage.

That roads should enter by ferry is necessary for all roads except those coming in on the peninsula, and even there, from Baden a transfer ferry at present, though slow, would be cheaper in cash outlay than any possible new track entering the city itself.

At some future day a pier bridge from Alameda to Hunters Point, as outlined by Colonel Mendell in 1870, or a cantilever from Goat Island to Telegraph Hill, may carry Oakland trains direct into San Francisco. However, bridging is as improbable as a tunnel under the bay. Ferries will do for years to come.

My conclusion is that there are no engineering difficulties in the way of competing roads.

I wish to acknowledge the courtesies shown me in getting the data concerning grades, by Wm. Hood and Mr. W. G. Curtis, of the Southern Pacific Company ; F. K. Zook of the San Francisco and North Pacific Railroad ; A. A. Grant of the California and Nevada Railroad ; Wm. Graves of the North Pacific Coast Railroad, and W. D. Johnson of the U. S. Geological Survey.

BRIGGS IN SCANDINAVIA.*

My valued friend, Mr. Briggs, of London, was the most sceptical man I ever knew; he believed nothing not supported by incontrovertible fact. His views were always tempered by a cynical philosophy, and his conclusions, aside from this, were usually of a sound common-sense kind. So long as modern progress and inventions were not the theme, not one man in a thousand could impart more information than Briggs, and always braced up with hard facts — stubborn, exact facts. Day, date, place, and circumstance he would have arranged like a chemist's jars, each in its place, labelled and classified for use. The following story will illustrate his methods of thought:

Business called me to Copenhagen in the unseasonable month of March. Spurred on there by an atmosphere that would have kept a sloth on the alert, the business at this place was soon dispatched. A night of rest at the Hotel Phœnix, was supplemented by a good breakfast, and I went into the reading-room, to while away an hour with the newspapers. A "Continental Bradshaw" was lying on a table, and I opened it to see what was said of Copenhagen — this old city which now wears an aspect as modern as any other lying south of it in Europe.

Turning to "Denmark," I read: "Its regal puissance stands contemporaneously with the proudest epoch of the Roman Empire." Studying some minutes to comprehend what this would mean in plain English, it gave rise to a feeling of interest in what would call forth such a panegyric in a guide book, and the next moment Briggs came into my mind. What a field was here for Briggs! A country whose regal puissance dated back to the Roman period must be rich in relics of the lost arts. Here Briggs could revel in proofs endless to support his peculiar views about things present and past, and might rake up material to form one of his most ferocious attacks upon what is new and inferior. I also remembered his speaking of this very country at our last interview.

I started out to look through the city. A few minutes served to reach the vast ramparts that once surrounded this old capital of the Vikings. Scores of men were engaged in digging and shovelling

*The present articles, here altered and revised, were written by the Editor of INDUSTRY, for a foreign publication, in 1885, and have not been published in this country. "Briggs," it need hardly be said, is the "Uncle Camshaft" of "Techno."

earth, and when the vast nature of the work and the insignificant means employed for its destruction were considered, it seemed a farce.

I climbed to the top and sauntered along, passing the old windmills and large trees that have for centuries stood like sentinels on the rampart, waiting the slow process of demolition that would finally sap their foundations and blot out their existence.

While turning these things over in my fancy, I saw a man approaching at a long distance off. He was wrapped in a huge "Ulster" coat; he had a queer kind of a fur cap jammed down low upon his head, and an umbrella. I watched him as he came nearer. Presently a huge pair of sandy whiskers came in view, filling out almost the entire space between the cap and the coat; other familiar marks followed, and "Briggs" stood before me! His style of walking was of a kind that might be termed the "military emphatic," and being absorbed in deep thought, it required a moment for him to collect his thoughts after he had "come to," as the sailors say.

After greetings and explanations, we started on together, but had only gone a few yards when Briggs stopped and began in his old style: "See these mighty works of engineering skill, reared by hands that labored, as many supposed, without the aid of science! Look at these pigmies, with their pickaxes and shovels, digging away this vast work, and think how many years must elapse before the destruction is completed! Picks and shovels at this day!

Here a gust of wind, that nearly carried us off the embankment, stopped Briggs and gave me time to inquire where he was lodged. He mentioned a hotel whose name is unpronounceable and forgotten.

"A grand old house, Sir! Very few modern innovations. A place where there is real comfort," said my friend.

I then proposed that we should go to the Hotel Phœnix, to escape the chilly air and enjoy a cigar while the Ramparts were discussed, adding that the tramway ran by the hotel. We started without Briggs saying anything beyond an assent until the bottom of the hill was reached, when as though he had held his breath during the whole descent, to accumulate force, he broke forth—

"Tramway! Do you know what a tramway is?"

Knowing that he expected no answer, I kept silent.

"Tramways are a substitute for good roads—an apology for bad roads. A shameful monopoly, that permits one person to be a

carrier and prevents another, who has equal rights, from enjoying the same privilege; destroys the streets, impedes traffic, and benefits no one except the shareholders! What is the distinction between a tramway and free street traffic?" continued Briggs. "I will tell you. There," pointing at the iron rails, "that's the distinction. Nothing more. Remove those rails and the distinction has gone. Improve the streets and the rails are not wanted. Lay down the rails and street improvement is ended, because there is from that time forth a powerful interest arrayed against street improvement. The worse the streets, the less the number of vehicles, and the greater the number will be who buy tramway tickets. I tell you, Sir," ——. Here the car came along, and we entered and took our seats. Briggs glanced around, to see if there was any one who would be likely to understand him, and began again as follows :—

"What did they do in Paris, in the Course La Reine?"

"Planted trees," I suggested.

"Humbug!" said Briggs. "They made a tramway, and the result is just what any sensible person who had considered the matter would have foreseen. The drivers—gallant as all Frenchmen are —would turn out and drive up to the side, as the omnibuses had done, to receive passengers. What next? The flanges on the wheels cut up and injured the asphalt paving, and the 'Prefect,' who attends to little as well as great things there, ordered that either the flanges must come off the wheels, or else the coaches must stay on the rails. The company took the flanges off the wheels. What next? It was found that without the flanges the coaches would not stay on the rails; and finally that it made not the least difference whether the coaches were on or off the rails. It was then discovered, as ought from the first to have been foreseen, that the *tram rails were of no use!* They were accordingly taken up, and the street again restored to its original state.

"Why, Sir," continued Briggs, "the same coaches are today running along the Course La Reine that were first put upon the tramway, only the tramway is gone."

I listened to this piece of history with interest, and called attention to the road we were then on, as being in good condition.

"Yes," said he, "these are the best tramways in the world. Carry you for a penny far enough to freeze you, and then divide twelve and one half per cent. per annum as earnings to the shareholders. This is an example of careful management by a careful

and well-governed people. In Philadelphia, the streets are so bad, through this tramway influence, that the cost of moving goods in the streets is double what it ought to be; costs enough to pave the city all over every two years.

"Why, Sir, if the deluded people had one half the sagacity that existed fifty years ago, the rails would be torn from the streets, they would be paved, and the same course pursued that was taken in Paris, and with a similar result. The cost of riding would be one half what it now is, and street traffic would be open to free competition, as it was before these schemes arose."

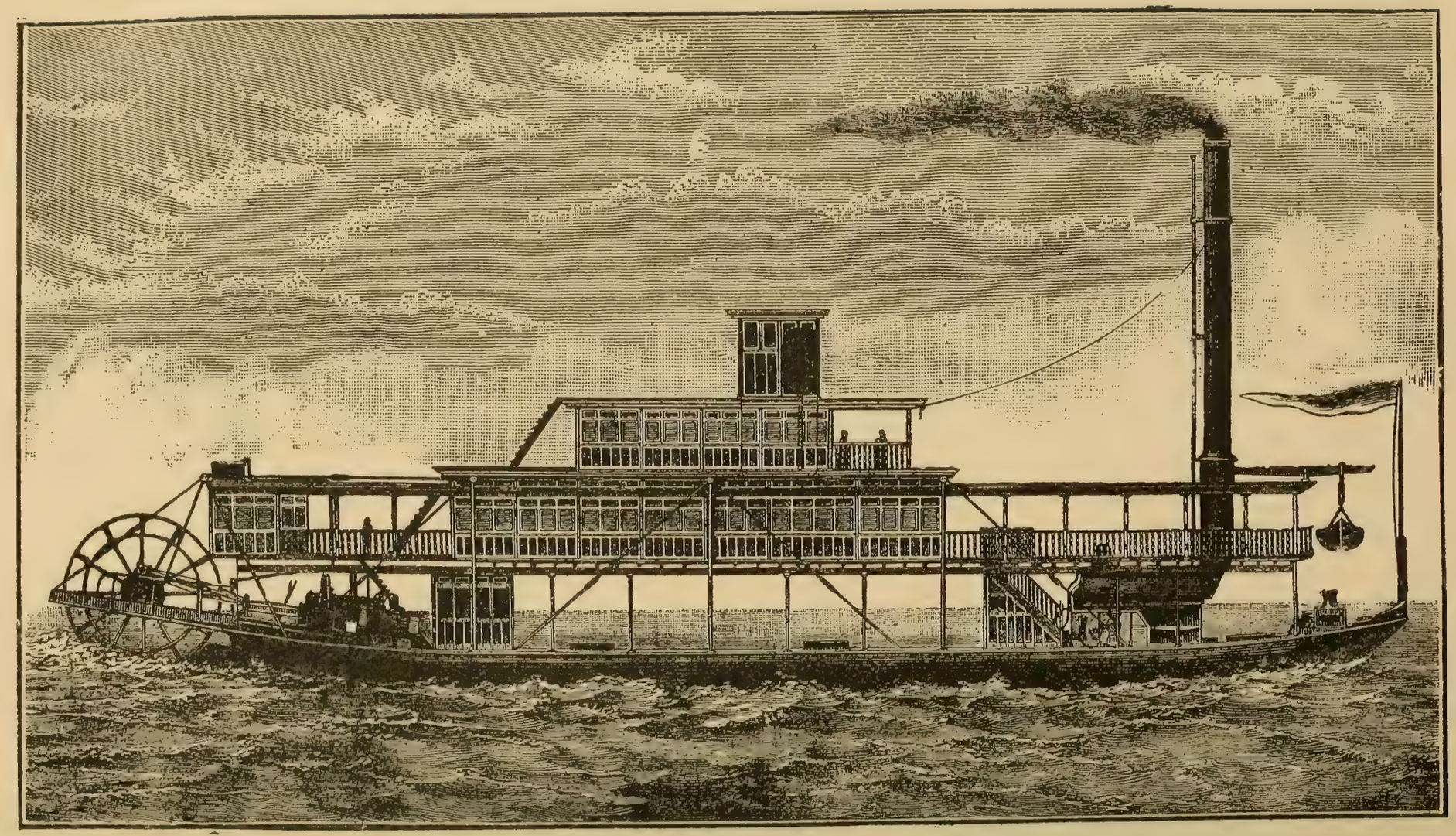
At this point we reached the hotel, and sat down in front of a huge stove, to be comfortable. I say we sat down in front of a stove; what this means will be understood only by those who have been in Scandinavia or North Germany, and will convey a wrong impression to those who have only seen and been stifled with those abominations called stoves, in most other parts of the world.

The stove was about thirty inches diameter, eight feet high! covered with handsome porcelain plates, and was only identified as the heating apparatus by its temperature.

Briggs, I knew, understood this phenomenon, which he called by some Scandinavian name. I asked him if this was a good plan of heating.

"Good plan of heating!" said Briggs, "it is, except open fires, the only plan of heating that will not kill a person of average strength in a three seasons. Look at the modern heating apparatus," he continued, "where the air is drawn into buildings, passed over a red-hot iron box called a stove, and then conducted to the rooms in pipes to — kill people. That is 'modern improvement.' You can put your hand upon the stove before you; the room, you notice, is warm and comfortable, and there is not as much fuel burned in this stove in a whole day as would be consumed in two hours in a common stove. As you go northward, and as the necessity for heating increases, the quantity of fuel consumed diminishes; or, to state it differently," says Briggs, becoming more excited, "as heating appliances have escaped modern inventors, they are, in the same degree, efficient, economical, and healthy. Wait until the inventors get to work, and see what the result will be. It takes three hours to warm this stove," pointing to the one before us; "but little of the heat passes out of the flue, and it requires six hours for the stove to cool again; the temperature never rises high enough to vitiate the air."

[To be Continued.]



Light Draught River Steamer.—Yarrow & Co., London.

LIGHT DRAUGHT RIVER STEAMERS.

YARROW & CO., LONDON.

The English builders of water craft have, for a number of years past, been trying to emulate the proverbial American steamboat that "runs on the dew," and are certainly succeeding in so far as draught, and exceeding in so far as uncouth design. Anyone on our western rivers who would construct such a looking craft as the one shown in the illustration opposite, would run a risk of forcible drowning. However, there are points, and good ones in so far as utility, even if her appearance does suggest a recent brush with a cyclone that removed the principal part of her cabins.

This vessel, the *Inez Clarke*, was built for the Magdalena River, South America, and has been in commission 13 years; is 150 feet long, 28 feet beam, draught 15 inches, speed 15 miles an hour. Another boat, the *Stephenson Clarke*, is a little smaller, and draws but 13 inches of water. The hull is of iron, and the open decks are preferable, because of the hot climate; other points of construction are clear from the drawing, which is a true elevation.

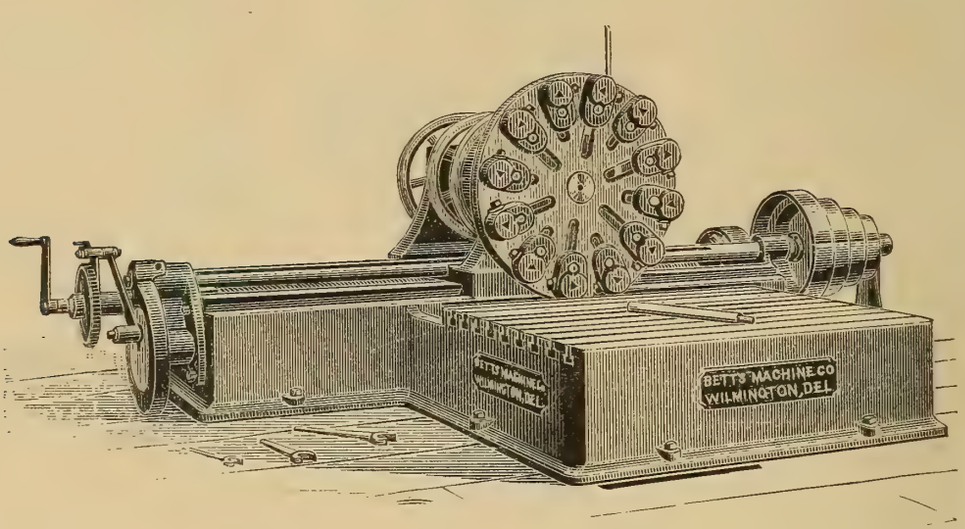
Steamboating in rivers, especially small rivers, where the "wheelbarrow" type of boats are employed, is a class of navigation, *sui generis*, that is not learned in books, nor by example even. Inference and analogy fail. There is no royal road to the art, it must be learned by "hard knocks." A whole corps of civil and mechanical engineers could not spar an Ohio River steamboat drawing two feet, over a bar where there was only 20 inches of water. They would know nothing of setting a spar, looking after hog chains, the wash of the sand beneath the boat, or the kinetic energy of river profanity. It requires a steamboatman, a man of quick perception, raised to the business from boyhood.

The steering, firing, landing and general conduct of a steamboat, including what are called "scrapes," far exceed the circumstances of deep-water navigation, with the advantage, however, that the vessels never get lost, that is, are never out of reckoning and never end without a proper obituary unless they "blow up." On the western rivers, and here on this Coast, they are made principally of pine wood, heavily coated with paint, and will burn up in ten minute's time.

With soft banks, and no snags, a boat will last a dozen of years or more by being patched and repaired for injuries. The passenger

steamers on the Mississippi, such as were in use twenty-five years ago, shook themselves to pieces in five or six years if their term was not shortened by explosion or other mishap. Their saloons were gorgeous in white and gold. The food served was of the best, and as a mode of travel has never been excelled, except in safety and speed, which is a wide qualification when one comes to think of it.

Old Captain Maguire, of the *Cambria*, gone forty years ago, was a "character" in those times. He owned the boat, and was jealous of her speed. On arriving at Cincinnati from New Orleans, a run of 2,000 miles, his friends would rush on board, and annoy the old captain by questions about the time of the voyage. In stating this he always put the days first. "Four days and four weeks, sir," he would say, and this was about the time required at that day.



ROTARY METAL PLANING MACHINE.

THE BETTS MACHINE COMPANY, WILMINGTON, DELAWARE.

Rotary planing, or continuous cutting, with multiple tools is the common dream of those not experienced in the art. The displacing capacity of any metal cutting machine is seemingly as the number of tools or edges acting at one time, multiplied by their velocity, and still more in the case of rotary planing where the tools act intermittently, and have time to cool between "cuts." This, as remarked, is the view taken of planing processes by those without experience, but there are other things to be considered.

One limitation is found in holding and presenting the work. It is not easy in the case of accurate planing to hold a piece without

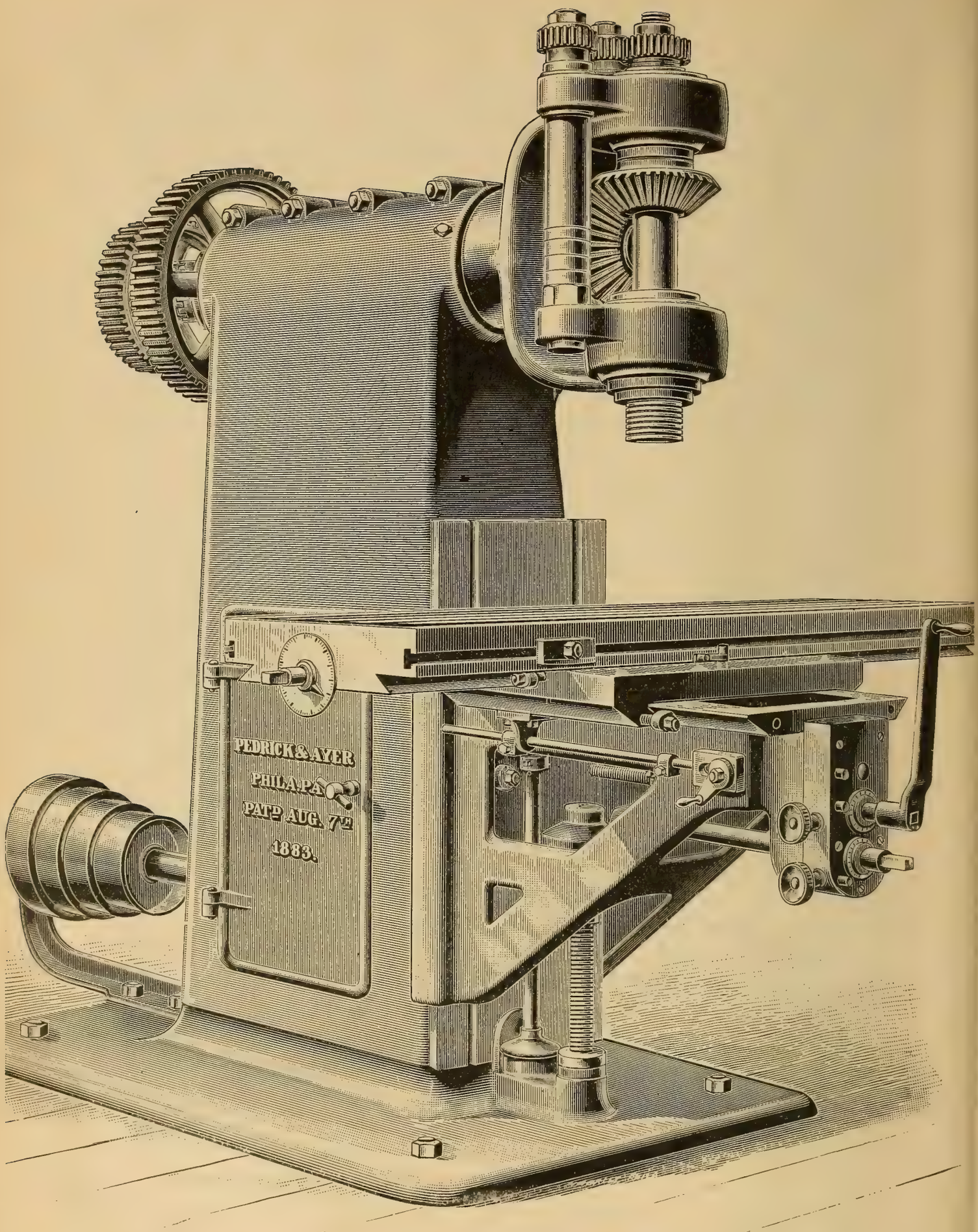
distortion, against the action of one tool, and there is also the difficulty of setting tools uniform enough to produce smooth surfaces.

These circumstances have, in common practice led to a prejudice and neglect of multiple tools in other cases where the cutting strains can be resisted, also distortion or springing of the work, and where smooth surfaces are not required. Much planing is done with single tools acting but little more than half the time, that could be performed at one fourth the cost by rotary machines like the one shown in the illustration.

The Betts Machine Company have, for a long time, been making and furnishing such machines for "butting" and squaring the ends of columns, the ends of metal framing, with other edge and end work of the kind. In the machine shown the cutting elements are fed past the work, which is fastened on the table seen in front, but there are various modifications to suit different kinds of work. The cutter heads are sometimes mounted on compound slides adjustable at any angle to the supporting table so as to cut diagonal joints. In other cases the tables in front are movable so that the work is continuous, new pieces being mounted while others are being planed. Such machines require great strength and good fitting ; some made by the company above named weigh over twelve tons. The tools are short pieces of fine steel set in sockets around the disc, twelve to forty in number, representing a corresponding cutting capacity without sharpening.

One of the most remarkable examples of this kind of working we have met with was at Crewe, in England, where Mr. Ramsbottom constructed a rotary machine of the kind to slot out inside locomotive cranks. It was a powerful one that displaced perhaps ten times as much metal in a given time as a slotting machine could.

They are really immense milling machines of large capacity, and, as before remarked, are much less employed than they should be in the rougher classes of work where speed instead of smoothness is the main object, also for a good deal of work which a common planing machine is not adapted for at all. The company have not sent any information respecting the capacity of the machines, but will, no doubt, supply it with other particulars.



VERTICAL AND ANGULAR MILLING MACHINE.—PEDRICK & AYER, PHILADELPHIA, PA.

VERTICAL AND ANGULAR MILLING MACHINE.

PEDRICK & AYER, PHILADELPHIA, PA.

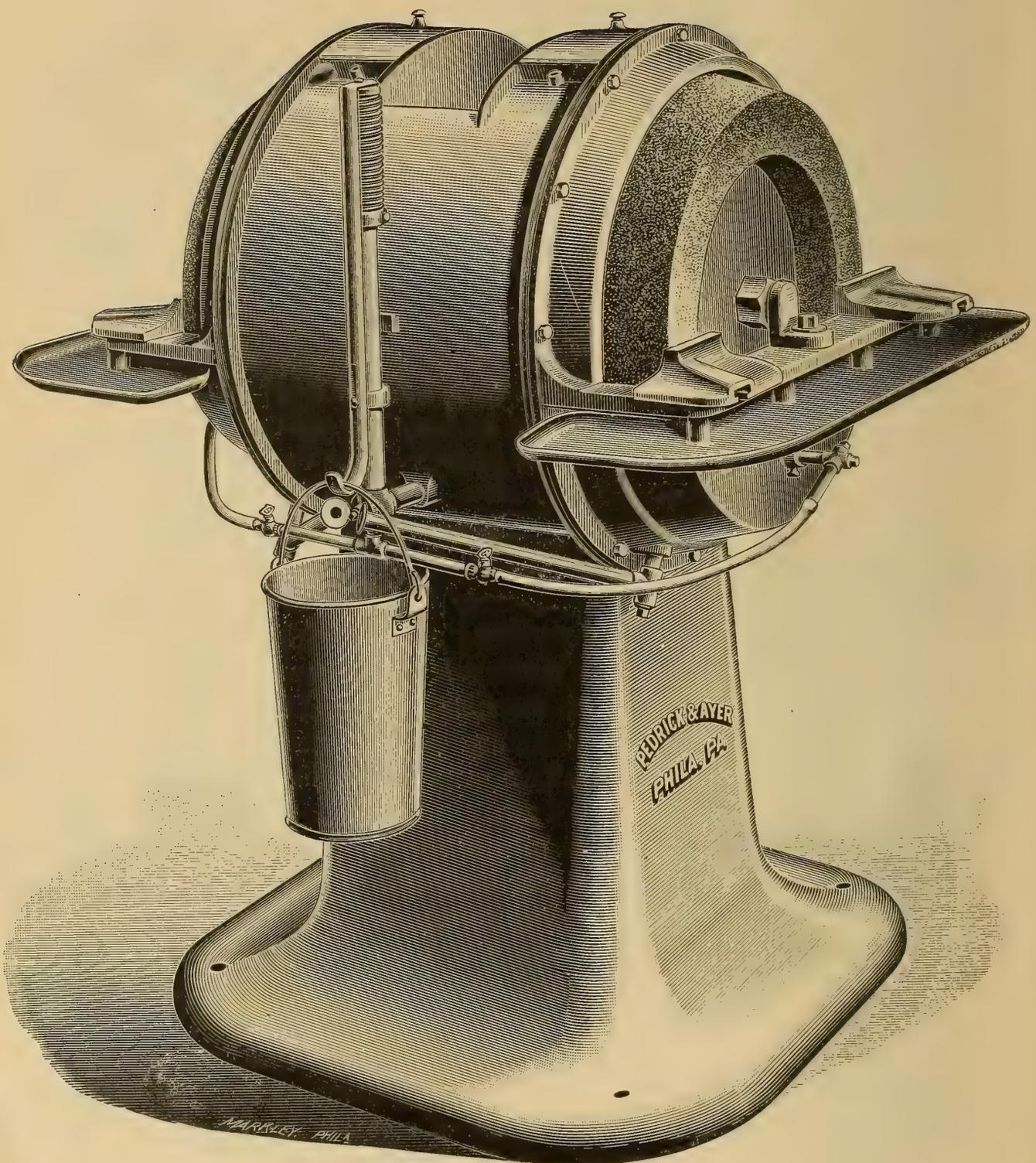
Three years ago we illustrated and described in INDUSTRY some milling machines made by the firm above named, just after a visit to their works, and an inspection of various things there. They make a specialty of railway implements, and, among other things, all kinds of milling machines of a very high class, having a peculiar compensating bearing for the main spindles that insures perfect rigidity, on which depends in a great degree the quality of work attained by milling.

The drawing opposite shows a new design, in which the cutter spindle stands vertical, or at any angle in respect to the table. The machine shown weighs 4,500 pounds, and has a spindle 3½ inches diameter in the main bearing, so as to operate on the heaviest class of work suited for milling. The various details are all well brought out in the engraving, made by Miss A. H. Markley, who has prepared the greater share of the fine illustrations that have appeared in this Journal during four years past.

We desire to point out the very sensible devices for clamping the main table independent of its sliding or gib joints. This is a simple addition, but one of much value, that should long ago have been applied to all milling machines of the kind. It is but a moment's work to turn up the clamping nuts, and the same thing is commonly, but in a less effective way, accomplished by tightening the gibs when heavy work is done.

The expedient is capable of a wider application. There are a good many cases where either the tool slide or the tables to support work are stationary when cutting is done, and in all such cases a set of independent clamp bolts would be a very useful improvement.

Another feature in the present machine, to which attention may be called, is the extreme simplicity of the design, especially the framing. One would think that a single view of a machine like this would displace in the minds of any draughtsman, the idea of scrolls, curves and ornament. Not a pound of metal is wasted, and not an ounce devoted to ornament. This very feature will, in the view of most purchasers, be a strong indication of excellence in the machine.



Double Tool Grinding Machine.—Pedrick & Ayer, Philadelphia, Pa.

DOUBLE TOOL GRINDING MACHINE.

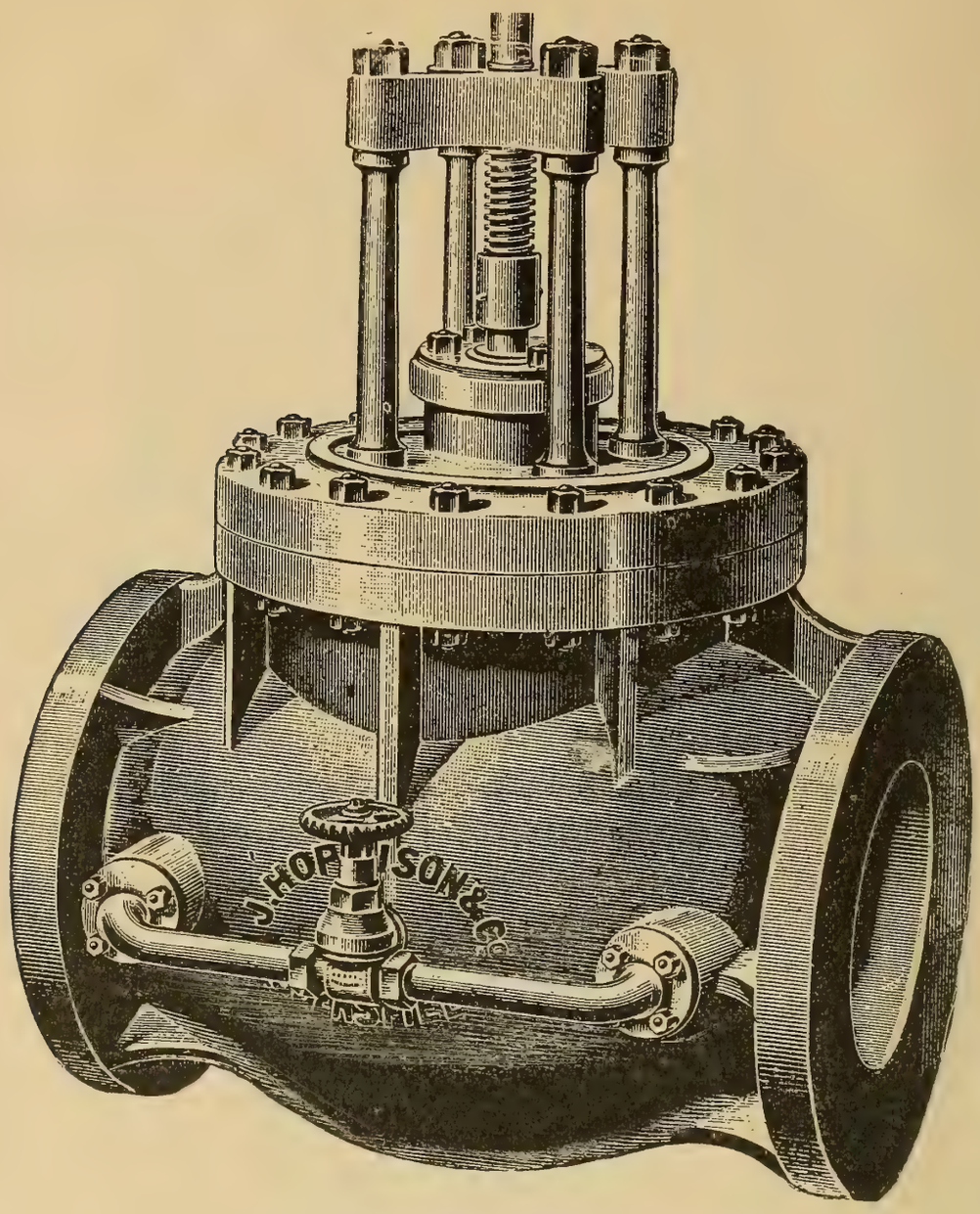
PEDRICK & AYER, PHILADELPHIA, PA.

The advent of emery-wheel grinding for tools in machine works about ten years ago resulted in either complete success or complete failure. No other implements have ever met with such diverse opinions as to their merits and value. In one works they would at once be pronounced indispensable, in another works they would be thrown out as useless after a few days or weeks of trial.

The reason of this was not in the machines, or the process, but in the system of use. An emery-grinding machine for general use is commonly a failure, for particular use is an important labor-saving adjunct, and performs work which grinding stones cannot do. By special use we mean used by particular persons who understand the nature and capacity of emery wheels, and, in shop terms, can "keep them up."

At the Union Iron Works, in this City, the main works were supplied with emery wheels for general tool grinding about eight years ago. The machines were of a very complete kind, and capable of good work, but the wheels were soon destroyed by rough and improper use, but in the tool room the result was the same as in all cases of proper use, a complete success.

These machines consist essentially of a frame, spindle and tool rests, with means of applying water. The latter was either circulated by small centrifugal pumps, or when plenty ran off to waste. The original frames and spindles were cheap and trifling, and a flood of water was required, because thrown off the wheels by centrifugal force as fast as applied. By degrees the machines took on better form, until they became well-finished machine tools, as shown in the design on the opposite page, and finally the water supply became automatic, so to speak, the wheels themselves performing the centrifugal pumping with no other change than being made of a conical shape, as shown in the drawing. The water runs on at the small end of the cone, flows by centrifugal force to the large end, and is discharged at a level high enough to run back again. It is neat and complete, dispensing with the pumping attachments, and, so far as seen, without interfering much, if at all, with the conveniences of use.



THE ENGLISH STOP VALVE.

The drawing above shows an example of design for a stop valve, adapted for high pressures, made by Messrs. J Hopkinson & Co., of Huddersfield, England. There is nothing novel in the design unless it be a careful and symmetrical distribution of the metal, all the sections being cylindrical, and consequently withstanding high pressure with a minimum amount of weight and thickness. The stem has non-adjustable packing, and the screw is placed outside where it can be oiled and cared for. The engraving is made from a valve of 15 inches bore to operate under a pressure of 180 pounds to an inch, but we imagine would stand double that amount. The by-pass pipe seems very small in proportion to the bore of the valve, but that may be so made to suit some special purpose.

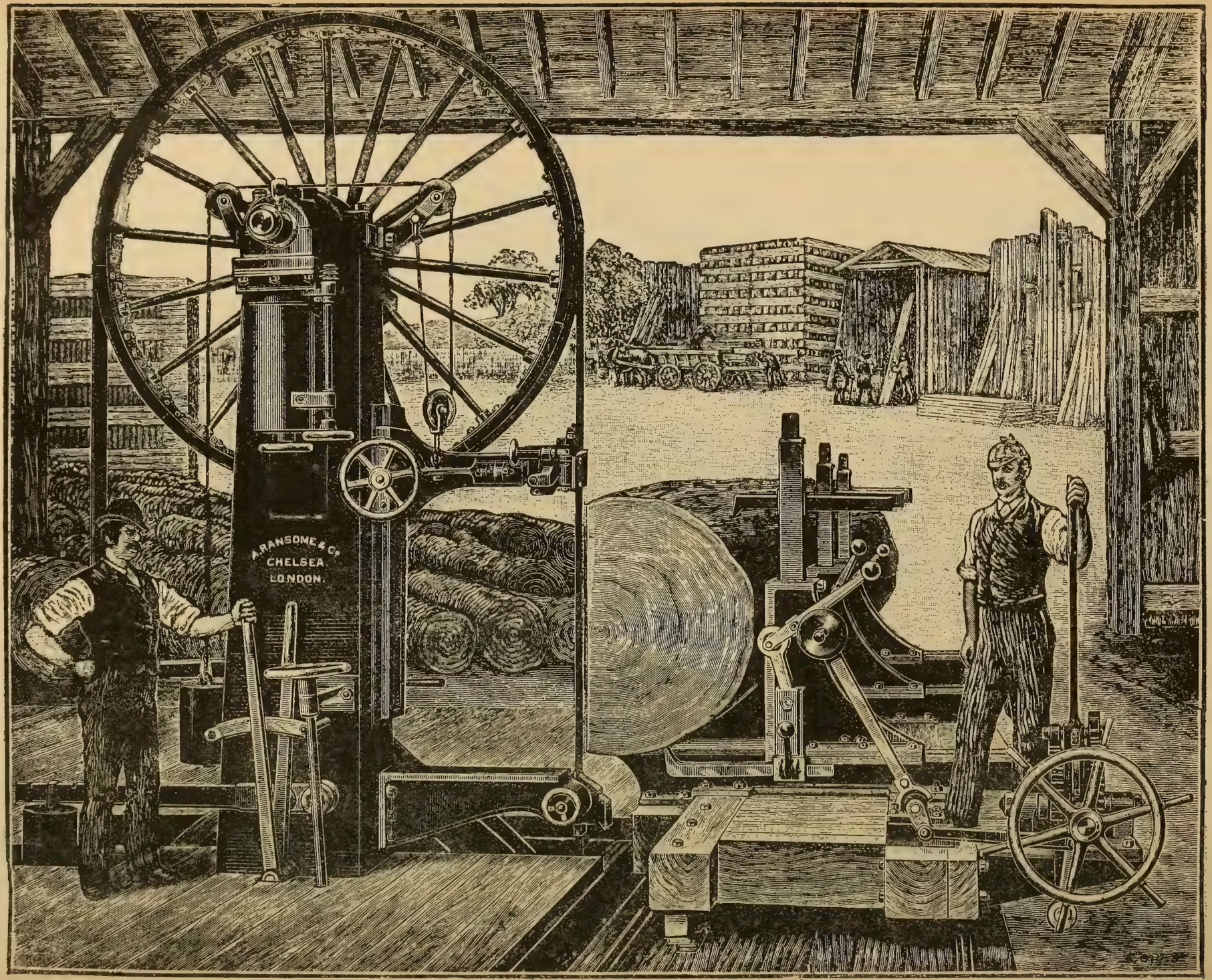
RAILWAYS IN THE UNITED STATES.

The railways in the United States make up a mileage of 170,601. Eighty per cent. of this is laid with steel rails. The capital is, in stock, $4,809,176,000; debentures $5,235,205,000. The following particulars, in addition to the above, are from an introduction to *Poor's Manual* for 1892:

Capital stock per mile of completed road	28,641 dollars.
Bonded debt per mile of completed road	31,179 "
Cost of road and equipment per mile of completed road	53,648 "
Passenger earnings per mile of road in operation	1,770 "
Freight earnings per mile of road in operation	4,591 "
Gross earnings per mile of road in operation	6,926 "
Net traffic earnings per mile of road in operation	2,168 "
Percentage of expenses to earnings	68.83 per cent.
Passenger earnings per passenger train mile	0.907 dollars.
Freight earnings per freight train mile	1.528 "
Gross earnings per revenue train mile	1.354 "
Gross expenses per revenue train mile	0.932 "
Net earnings per revenue train mile	0.422 "
Proportion of passenger earnings to gross earnings	25.84 per cent.
Proportion of freight earnings to gross earnings	67.00 "
Proportion of other earnings to gross earnings	7.16 "
Earnings per passenger per mile	2.184 cents.
Earnings per ton per mile	0.929 "
Average distance per passenger	23.95 miles.
Average distance per ton	115.29 "
Interest per cent. of bonds	4.25 per cent.
Interest per cent of bonds and debt	4.10 "
Dividends per cent. of stock	1.85 "
Interest and dividend to stock, bonds, and debt	3.06 "

AMENDMENT OF CANADIAN PATENT LAWS.

The Dominion of Canada has enacted an amendment to the patent laws of that country that will have an especial interest here on the border. The Act of July 9th, 1892, provides that in addition to one year's time permitted to inventors for applying in Canada for patents previously granted in other countries, the inventor shall be protected during this period if he will file with the Commissioner of Patents, at Ottawa, notice of intention to apply for a Canadian


ARANSOME & Co
CHELSEA
LONDON.

patent, and the patent if granted will hold good against any manufacture of the same commenced during the year of intervening time before named. There is also provision permitting oath to be made before a justice, notary, mayor of city, judge of a court, or consul of proper jurisdiction.

Models, heretofore essential in all cases that could be so illustrated, are not required except when demanded by the Commissioner of Patents. This is the same as the regulation in this country, and means a saving of nearly or quite one half in the fees for a Canadian patent, the models in most cases costing as much as the Government fees.

The full term of patents is extended from fourteen years to eighteen, and is divided into three periods of six years each, or, in other words, the fees can be paid for six, twelve or eighteen years as preferred, with the privilege of extension accordingly.

The provision requiring manufacture in Canada grants two years for that purpose, and one year for importation into the country, of patented inventions.

ENGLISH BAND SAW MILL.

A. RANSOME & CO., LONDON, ENGLAND.

The plate opposite, from an engraving of an English band saw mill, will have an interest to our wood-working readers.

The band saw struggle, to so call it, has in England, as in this country, gone on for the last twenty years, in so far as sawing large rough timber. For the finer kinds of work the French machines of M. Perin of Paris were, thirty years ago, brought to a state of perfection not much improved since, except by simplification, and in symmetry of construction, but for sawing logs we can only now claim to have progressed to a successful point.

Messrs. Ransome & Co. began, in 1868, to make band sawing machines of various kinds for wood and metal, and have continued ever since making various types, keeping a close watch upon American practice, which has been bolder, and in the end more successful than in France even, where the "art" may be said to have commenced. French log-sawing machines, some of which were brought to this country in 1871, have not succeeded very well because of their construction conforming too nearly to the "scroll-saw" type, such as are made for fine work.

The saws were highly and rigidly strained, driven at high speed with a slow feed. This produced true work, and suited for sawing fine and valuable wood, because the cutting was perfect, and wide boards were produced precisely parallel in thickness, but the dulling of the saws in proportion to the work done, and the slow feed, rendered the machines useless for what we call mill purposes in this country.

A continuous struggle with the problem for more than twenty years past has, however, demonstrated the fact that a band saw can be made to cut nearly as fast as its "tooth velocity" when compared to circular saws, and that the saws can be made to run without deviation when only moderately strained.

Referring to the drawing, the machine shown is massive in construction, the top shaft being made large enough and so mounted as to avoid flexure. A failure to make such shafts large enough has led to the use of an outside support in this country, which, by the rules of machine construction, is unnecessary if the strain is provided for by a large shaft when the wheels are overhung. The driving wheels of locomotives, for example, are overhung, and the bearings withstand not only more pressure than band saw wheels are subjected to, but run often at higher rotary speed, that of the bearings being from 250 to 350 feet per minute, but such wheels are not mounted on shafts of small size as band saw wheels are, so the problem of an overhung wheel in this or any other case is one of "compensation."

The writer, in 1870, designed band sawing machines of the smaller class with the top wheels running on fixed studs, and was severely criticised for so doing. Since then thousands of machines have been so made, and to this time cause much less trouble than those with double bearings. The strain of the saws is central on the bearing, and there is no flexure, which is nearly always the cause of the bearings heating.

The carriage employed by Messrs. Ransome & Co. is one of American design, as all those of quick movement are.

There is a good deal of American timber of large size to be sawn in England. The railways, and railway carriage makers, usually buy tulip, walnut and other woods in the log, and cut it up into such sizes as are wanted, hence there is a fair share of deep sawing to be done there as well as in this country.

LITERATURE.

The North American Review.

DECEMBER, 1892.

An article, in this issue, on "A Blow at the Freedom of the Press," by Mr. Hannis Taylor, will, perhaps, be more widely read than any other. It is based upon a recent decision of the Supreme Court of the United States, in which it is held that the government possesses the right to exclude from the mails any matter which Congress may consider injurious to the people, or to public morals. These are not the precise words, but the essence of them, and the decision is in the same line with some others of our time that manifest an autocratic tendency of the judiciary.

We have neither space nor inclination to attempt a digest of Mr. Taylor's article, which is legal in nature, but have in mind, in such connection, a reported use of the Post Office Department for political purposes, or rather the non use of it, by holding over printed campaign matter until after the election. The only power of Congress under the first amendment of the Constitution is to exclude certain defined kinds of matter from the mails, and does not authorize any discretion as to what is obscene or immoral, but only as to degrees. A Congress of political partisans would easily conclude that tracts of the opposing party were particularly injurious, and should be suppressed.

The leading article by Mr. Balfour, on the Irish question, in the new House of Commons, is another of these essays, becoming tiresome, in which English views and traditions are set up instead of particular facts. The truth is, that no Englishman, or at least none more than Mr. Gladstone, understands better, or can conjecture nearer, the result of home rule in Ireland, and he does not know much. Of all countries in the world Ireland most needs the excitement incident to the management of her own domestic administration, and it is possible would astonish the world at her success in such things. Who knows? We are sure Mr. Balfour does not, and the utopian result he pictures of a homogeneous empire is not approaching but receding.

The great difficulty and root of the problem was a confiscation by conquest, tempered by a fanatic and intolerant faith, and there are, for this reason, no moral grounds on which to base coercion. It would be better, all know, if Ireland were an integral and contented portion of the United Kingdom. No one doubts that, but the foundation was laid in wrong, and the penalty is to be endured.

In any case, no one in this country, not an Irishman, can see why we are to be plagued with, and mixed up in the matter, especially as no one, or at least not one in a thousand, has any understanding of the problems at issue, and much less of causes that have raised up these problems and maintain them. Their discussion, in this country, by Englishmen, should cease.

Technology Quarterly.

This publication, emanating from the Boston School of Technology, comes to hand in the usual dress, with sixteen articles, occupying 136 pages. Among the articles of most interest is one on a hand telescope for stadia surveying. It is too technical for comment, but opens out some new problems of interest in what promises soon to be a useful method of defining lines and boundaries, especially on this Coast, where chain work is almost impossible over three fourths of land to be surveyed.

As usual a great part of the matter is devoted to chemical research and problems, a result of the prominence given to that branch in the Boston college. We published, in our last issue, a considerable portion of one of the articles, on the construction of Breech Loading Mortars.

The Sibley Journal of Engineering.

VOL. XII, NO. 2, NOVEMBER, 1892.

This number contains the inaugural address of the new president, Professor J. G. Schurman, the third that has presided over

that institution, a branch of Cornell University, which has an endowment of $8,000,000, a revenue of $500,000, accommodates 1,600 students, requiring a faculty of 150 professors. This institution is a prominent fact in the affairs and future of the state.

New York appoints 500 students, which return in all only $20,000 a year, and 1,100 other students $110,000 a year, but the revenue is insufficient.

The Sibley Journal is replete with original articles of a high and useful order.

Consular Reports.

JULY, 1892.

A crowd of other matter has prevented our usual summary of industrial points in these useful publications, and must, in the present case, be restricted to brief mention.

In the July number the article on the "Commerce and Industries of Hawaii," by Consul General Severance, at Honolulu, will have especial interest here in San Francisco. The yield of sugar last year exceeded the previous year by 16,000 tons, but the whole loss over the previous year in money, because of the McKinley act, is estimated at $5,000,000. The effect of this can be imagined on a population of 90,000, when the value of plantations is only $32,347,000, and of everything in the Hawaiian Kingdom but $39,000,000.

The commerce of Hawaii, while it is not great, is an important factor here, amounting in 1891 to 173,891 tons of merchandise, of which to the value of $15,118,339 came to San Francisco, and with $372,217 to other ports constituted 87.5 per cent. of the whole. The exports in 1891 fell off from the previous year $2,880,000, and will, no doubt, still farther decrease in the present year.

Consul Frail, at Marseilles, France, contributes a valuable report on the manufacture of vegetable oils, accompanied by drawings of various kinds of apparatus employed in the processes. Marseilles, it seems, is a great center of this industry, there being there 45 oil mills, employing 3,000 people. The export of vegetable oils amount to 36,950,000 kilograms, or more than 40,000 tons, which, if there is no mistake in figures, is amazing. The factories contain about thirty presses each, and with that number can treat 50,000 pounds of seed per diem.

Here in California, where there is such prolific growth of seed plants, one would think that this oil industry would be very profitable. Castor beans yield 30 per cent., rape seed 22 per cent., peanuts 50 per cent. of oil. The product is sold all over the world, but mainly in the Latin countries.

The Reports on prepared, or as we say, "patent" medicines from European countries form an interesting section. In Russia they are nearly prohibited, and in several other countries subjected to various restrictions.

AUGUST.

The August number is almost wholly devoted to commercial statistics, including, however, an interesting account of trade disputes at New Castle, England, which indicates how serious wages controversy becomes when business is done on a narrow margin of profits.

The Swiss telephone system, the cheapest in the world, is described by Consul Beyer.

SEPTEMBER.

In the September number (144) Consul L. W. Myers, of Victoria, reports on the coal mines of Vancouver, Island, as before noticed in this Journal.

An article on the Magdalena River and Valley, by Consul Johnson Nickeus, at Baranquilla, will be a surprise to a good many who are not aware of there being in the Republic of Columbia a large river, navigable for 800 miles or more, and draining an area of 110,000 square miles.

This river is navigated by twenty-five steamers, one leaving Baranquilla daily for Honda, 615 miles distant. Honda has now 6,000 inhabitants, only one fifth of what it had once, the cause of this decadence being an earthquake which destroyed the city in 1808, and killed there, and at Marquita, 12,000 persons. The Consul estimates that the City of Cartagena, and its fortifications on the river, cost $75,000,000.

OCTOBER.

In No. 145 for October Consul W. P. Pierce, at Trinidad, sends a voluminous report on asphaltum. The pitch lake there is one of the wonders of the world. It is a circular pool with an area of only 109 acres, but contains a volume of pitch, estimated at four to five millions of tons. The pitch is saturated with water in its natural state, and

is not sticky until the water drains out. It is presumably of vegetable origin, but developed through changes that must be left to the field of conjecture.

The pitch is dealt with by an American company that have paid some heavy concessions to the government, including a duty, or seigniorage, of $1.60 per ton on the pitch.

Postmaster General's Report.

FOR THE YEAR ENDING JUNE 30, 1892.

This report indicates, as have others of Mr. Wanamaker, a good deal of trade vigor in his department, and the usual idiosyncrasies of style and diction. Common custom has assigned the privilege to great generals, of writing their dispatches in the first person, and, perhaps, the "Generals" of the Postal Department should have the same privilege, at any rate we find the personal pronoun repeated ten times in the first seventeen lines of the report.

The facts are, however, the main part, and in these appear a wide extension of the service, including the ocean contracts with eleven different lines, or routes rather, because nine out of the eleven contracts are let to one company, the name of which is not even given except "O. M. S."

This is a most unhealthy looking phase of the contract matter, showing, as we claimed last year, that there is no competition in the case, and that all the advertising and bidding was a mere sham. Open competition is a very repugnant method to those who contract for government service in this country, and it is to be hoped that in future this collusion method will not be tolerated.

The financial statement shows a deficiency of five and a half millions, about the same as the two preceding years and an estimated deficiency of only $1,552,423 for 1893, and a "surplus" of $872,245 for Mr. Wanamaker's successor in 1894. These estimates for his successor, considering the circumstances, is decidedly "cool."

The Columbian system of postage stamps, as well as a good deal more, will call to mind the store at Philadelphia and shop-keeping.

There is no denying that the present Postmaster General has introduced a great number of innovations, some of which will last, and some of which will disappear, but whatever good has been done will be, no doubt, buried with the circumstances of his appointment.

People in this country are apt to forget very rapidly, wrongs committed under a system of blinding partisanship, but the "Philadelphia fund" will pass into history with Senator Ingal's "Iridescent dream." as one of the most flagrant examples ever committed in thwarting the aims of popular suffrage.

University of California College of Agriculture.

VITICULTURAL REPORTS.

Prof. E. W. Hilgard's office is no sinecure. People with great suddenness have awakened to the fact that agriculture, especially in California, is not only amenable to those scientific methods and discoveries such as build up other industries, but is peculiarly so. It might even be said that without scientific investigation the wine, fruit and sugar industries could not be founded and maintained here.

One may grow cattle, potatoes, and wheat, on the lines laid down elsewhere, and on training gained in almost any country, but the production of wine, the care and preparation of fruit, beet sugar, also the intense agriculture under irrigation, require something more than experience elsewhere, and the department of agriculture of the State University has called for a great amount of careful labor, successfully supplied under Professor Hilgard's administration.

It is not within the province of this Journal to review the subject matter of the two reports at hand. One of 345 pages, Part I, "Viticultural Work from 1887 to 1889," and the other on "Methods of Fermentation" of 48 pages, dated 1888.

The conclusions and inferences are to be taken mainly from tabular data, and cannot be stated in the abstract.

Perhaps the best we can do will be to quote a paragragh, or two, from page 37 of the last named report:

"*European Practice.*—The objectors say that the wine-makers of Europe have made good wines for a thousand years, and have known nothing about all these things; then why should we?

In the first place, as a matter of fact, a very large proportion of the wines made in Europe are very far from being the best that could be made under the prevailing condi

tions; a fact certified to by every œnologist of that continent.

Secondly, the experience of centuries has there taught the wine-makers of each region how to treat the wines, by rule of thumb, so as to make a fair article, suited to *their* taste at least.

But now that rapid communication is opened up between remote districts and their wines are compared by the general public, the faults of the local products are brought to light and œnological stations are struggling with all their might to overcome the bulk of vicious old habits.

As yet we have in California no settled rule-of-thumb that may not be readily gotten rid of among a progressive population, *by proper instruction in the principles of wine-making, which had held good everywhere, no matter how the material and the practice may vary.*

The California Vine Disease.

BY NEWTON B. PIERCE.

[U. S. Department of Agriculture, Washington.]

This report is one that we cannot hope to notice in a way commensurate with its merits. Its merits, as a technical production of a very extensive kind, will, in a measure be lost, because of the faint hope held out against the ravages of vine disease on this Coast.

We commented, a short time ago, on the state of the vineyards in Napa Valley, and are now astonished to find that causes, unlike in many ways, but equally potent, have been at work throughout California, and on the peninsula of Lower California, and that this Coast is likely to suffer, as France has done, a gigantic loss in an industry on which the highest hopes were based.

Mr. Pierce has done much with the resources given him, and not content with these, added, at his own expense, the collection of extensive data in southern Europe, so as to derive from there, if possible, some light upon the genesis of vine disease, and remedies for its prevention, but the fact is that the subject is so extensive, reaching into temperature, soil, seasons, and the obscure chemistry of growth, that there is a paucity of data on which to build such conclusions as are presented. Mr. Pierce in his conclusions says:

"The review of viticulture in Mexico and the peninsula of Lower California, combined with that of about one hundred and ten years of vine growing in southern California, has clearly shown that no widespread death of vines similar to that occurring since 1884 has ever before been known in North America, although the vine now most susceptible to the disease has been grown on the continent for more than three hundred and fifty years. The exceptional nature of the malady is thus established. It has also been shown that if climatic conditions have any casual relations to the death of the vines, these conditions are both recent and exceptional. Hence, the examination narrows the matter and period to be investigated down to the exceptional phenomena of a single decade."

There is in the nature of the problem hopes of prevention, not certainly in previous history, but by analogy to human pathology, and in modes peculiar to our time and the resources of modern science.

Professor Pierce does not deal with remedies. These can be discovered only empirically before the nature of the disease is made clear, and this is so far from the case that the author is obliged to remark that:

"The facts point to the present existence of the inciting cause of the disease as either an external parasite or as internal and cumulative."

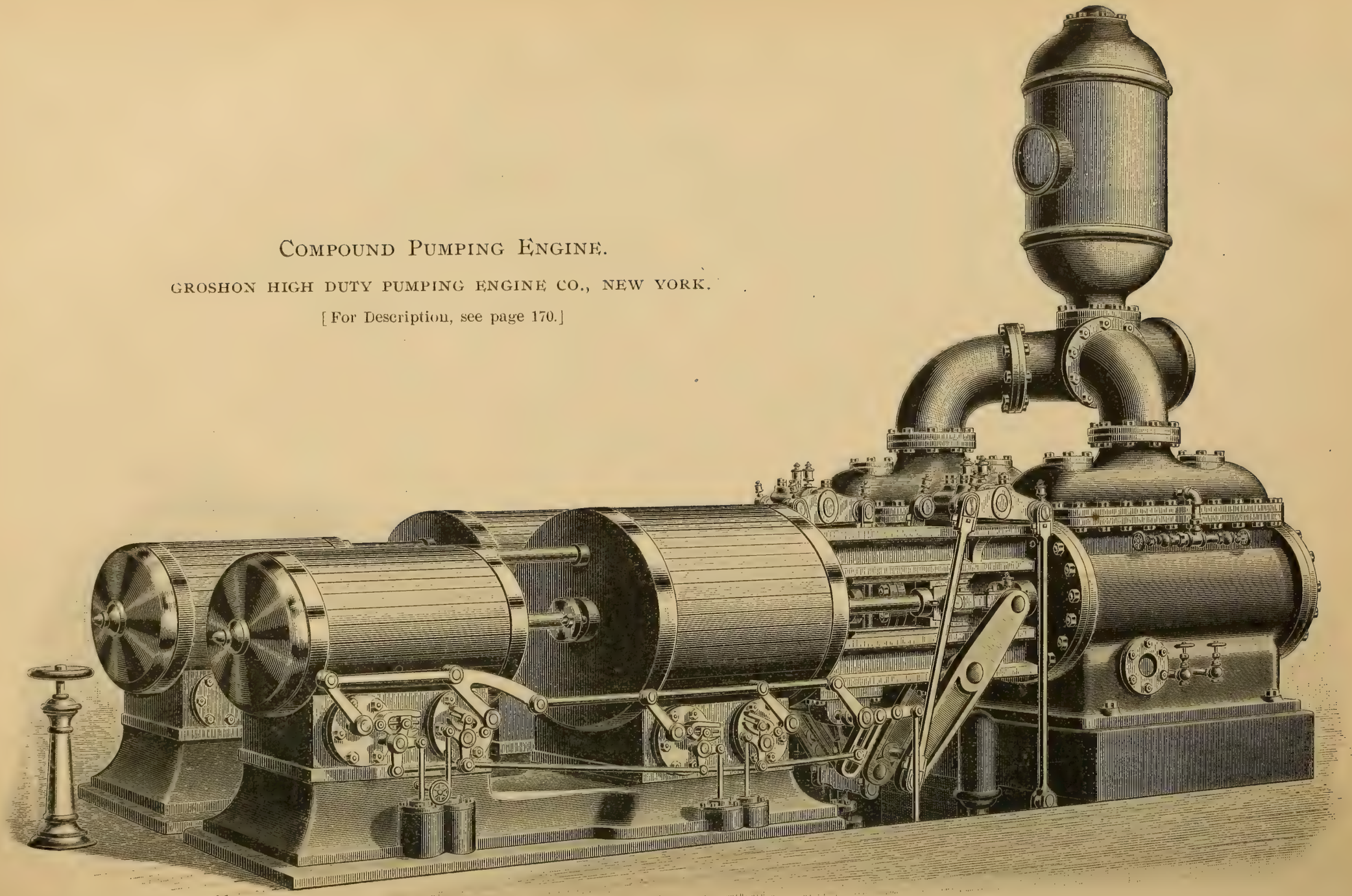
The principal good that can come of this or other notice of this valuable report is to urge California vine growers to read it carefully, and then report to the department, at Washington, any observed phenomena, not here treated, or in any way varying from or adding to what is given.

The book contains a large number of fine plates, and what is unique as well as of especial value, a chart showing the effect of shade on vines.

Compound Pumping Engine.

GROSHON HIGH DUTY PUMPING ENGINE CO., NEW YORK.

[For Description, see page 170.]



"INDUSTRY."

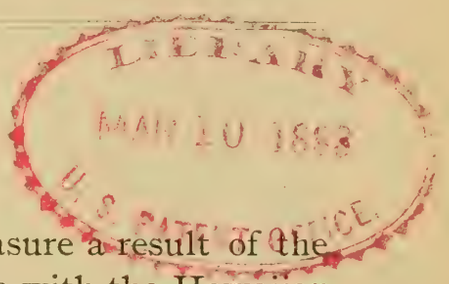
JOHN RICHARDS, EDITOR.

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COMMENTS.

The Hawaiian revolution is in a great measure a result of the reciprocity business. In 1875 a treaty was made with the Hawaiian Government admitting sugar raised in that dominion free of duty, and as the prices elsewhere were not effected, this was the same as paying a bounty of two cents a pound to Hawaiian planters, amounting to about $5,000,000 a year, but no one here except those owning plantations in Hawaii gained much by this concession. The loss of this bounty by the late tariff act cut off this revenue, and the only way of renewing this advantage is by annexation, so the present bounty of a like amount, paid in the United States, will apply also to Hawaii. This is the main cause of "revolution." There are about 50,000 Chinese there, nearly all of the lowest class, and to invite these "within the lines" is another fact of annexation. There is also another item of 40,000 "contract laborers," which we fear are very much in the same category with the people affected by Mr. Lincoln's emancipation proclamation. There are many other objections, and the countervailing advantages are by no means so apparent or important. There are now all the privileges there we need, and no expense of guarding them. It will be best to well consider such a serious and unprecedented matter as annexing 100,000 people of different races with only 3 per cent. of Americans among them.

Mr. Z. S. Holbrook, of Chicago, has delivered a lecture on the labor problems recently, which the *Iron Age* calls the "most forcible, logical and thoroughly sensible contributions on this subject," and quotes as follows; "capital is denounced as a criminal acquisition; the successful merchant or manufacturer is the real criminal of today," with more of the like, which is simply answered by saying it is not true, and so far from being true is just the opposite of it in respect to the popular estimation in which honest wealth is held in this country. Not only is the honest rich man respected, but his failings are condoned by the fact of his wealth, and we suspect that Mr. Holbrook means rich "rascals" when he speaks of rich men. Stephen Girard was a rich merchant, the richest in this country at one time, but no one ever heard him called a criminal. Peter Cooper was a rich manufacturer of our time, but he never suffered obloquy, and we think Mr. Holbrook will have trouble in finding any blameless rich man in this country that is not looked up to and respected by those with whom he comes in contact. No one can say that the prejudice against wealth has not much cause in the methods of its acquirements at this day.

Mr. Thomas A. Edison has just been granted a patent, Number 490,953, Jan. 31st, 1893, entitled "Art of Generating Electricity," that will cause some comment, not so much because of its nature and objects, but from the fact that the application was filed Nov. 1st 1883, over nine years ago. The first claim out of nine reads as follows:

"The improvement in the art of generating electricity, consisting in causing the dry decomposition of a chemical compound in a rarefied atmosphere, and in the presence of a positive element, which is attacked by such compound and is electrically charged thereby; and a negative element, which is electrically charged by the dry chemical reaction, substantially as set forth."

The holding of a patent for nine years by circumstances which the present laws permit, is not an equitable proceeding. It is possible, perhaps, in some cases that long delay is necessary by reason of interferences and other causes, but not for nine years.

How many ever stop to think that in a system of popular or representative government the vicious expect to be represented as well as the honest. If the boodler, the smuggler, gambler and the lowest in a community are not to be represented, why should they vote? These are inherent faults in the system. It is based on the

supposition that a majority of those voting are honest people having only the good of community in view, but supposing this is not the case, how can anyone complain of government and laws made in the interest of the majority, or in any case, to operate impartially. The machine politicians want men to represent them, and why not? Why indeed should any numerous part of community not have their share in government and the formation of laws in proportion to their voting strength? Any faction that commands a majority of votes has a right to use that power to their advantage and do so. On the same method any great interest, such as the railways, the iron, coal, or oil interest have similar rights and assume them.

The Patent Bureau of the Department of the Interior is not a demonstrative part of the government. There is no connection or intercourse with the outer world that permits any popular knowledge of the ability and qualifications of the officers in the Patent Office. Except the Commissioner, their names are scarcely known, yet they are called upon to exercise intricate executive, and even judicial functions, that affect in a serious way the industrial interests of the country. The Patent Centennial, held in Washington in 1891, permitted, almost for the first time, a contact between the public and the officers of this important bureau, and the inception of these remarks is due to having received a printed copy of an address delivered on the above named occasion by Col. F. A. Seeley, the principal examiner of the U. S. Patent Office. We produce in another place, one section of this address, being an essay on the property in inventions, from an international standpoint. The historical portion is not less interesting, but our space will not permit its reproduction at this time.

Dr. Joseph Holt, of New Orleans, which, he claims, is the only well guarded city in this country, has written a work on "Maratime Sanitation" that will make timely reading for this season, and discouraging reading too, in some respects. Few people understand the nature of the controversy at New York over the quarantine matter, last Autumn. "It was politics mainly." Dr. Holt says in speaking of the quarantine regulations, "that on the lower plane of spoils, the States have tried to retain practical control because of the patronage involved, and the spoilsmen because of fees." If quarantine regulations are left to States they may as well be left alone. About all the executive business that is transacted with any

exactness, is Federal, and by analogy as well as common sense, the quarantine laws should be national. There is neither probability nor hope of quarantining the country under State regulations and officers. There may be in some cases a careful and efficient service, and in other cases not. It is a problem concerning the country as a whole, and demands action in the present Congress, if there are no general laws to apply.

We have had occasion twice before, to call attention to purchases of machinery abroad by those thrifty patriots, the Carnegie Company, and now learn from an English source, that there is being made at Bolton, England, a large steam engine, to be sent out to Pittsburgh. The only particulars given are that the fly wheel of the engine weighs 90 tons, and the presumption is that the engine is to drive roll trains. The same writer said, "not long ago, Messrs. Galloway, of Manchester, sent a large pair of engines over there" meaning, as we understand it, to the Carnegie works. The fact is, that Mr Carnegie like many others, want free trade for what they buy, and a tariff on what they sell, but one would think after writing "Triumphant Democracy," Mr Carnegie would order his machinery at home, no matter what its price. If there are faults in American machine tools, and the imported ones are better, why is not the fact set forth? It would be of much value, and would at once call out successful emulation in this country.

Mr. R. P. Bland, in the *North American Review* for February, in a symposium on the silver problem, gives out a truth that has been singularly overlooked, namely, that the Brussels monetary conference was a ruse to direct people's attention from the matter during the last presidential campaign. Mr. Bland says "the moving cause of the conference on the part of our Government was to defeat or postpone legislation on the silver question, and to amuse and deceive the people pending the presidential election." This is candid, and as anyone who can remember the events can affirm. Mr. Bland makes an economic problem of the matter, and speaks of fixed salaries, "shylocks," and the rest, making mystery where no mystery exists. If silver becomes cheaper there must be more of it put into the dollar, that is the whole story, and the economic question narrows down to the interest of those who are either producing or own silver. The distinctions between a "base" metal, and a

"money" metal are amusing, or rather are meaningless. The whole subject requires very careful handling at this time.

A written constitution may be a convenience for law makers too ignorant to understand the scope and limitations of useful and just legislation, but it is at the same time a cause of the contempt in which laws are held. We use the term "contempt" in its legal sense, meaning a disregard of laws and indifference to their provisions. The Exclusion Act of last May, under which Chinese laborers are to be enrolled, is an example. It was an "impulse" act in deference to spasmodic opinions, and has not been carried out. It is an alarming idea that Congress will enact in all solemnity a law that no one regards. The reason, or one reason for this, now appears in the decision of Judge Nelson of the U. S. District Court in Minnesota, that pronounces such an act "unconstitutional," and consequently void. The Supreme Court will probably confirm this decision, and then we will stand before the world in a position of legislative stupidity. It don't matter much, what the final ruling is, because as before said, the law has not this far been enforced. Of its merits we venture no opinion, but the "execution" is bad.

Now will be a good time for those who laid away some of the tin literature of last year to bring it out for reperusal, and from which to form an opinion of how the Nation is served by those entrusted with legislative power. Under the last tariff act, known as the McKinley Bill, a duty of 2.3 per cent. a pound was levied on tin plates, but not to be collected for eighteen months, so the importers and chief promoters of this measure could make two or three millions of dollars in speculation. A duty of 4 cents a pound on pure tin is to be assessed after July of this year, giving a second opportunity for speculation. The excuse for this tax was the development of tin mines in this country, which would long before have developed themselves if there had been tin in paying quantities. The Temescal fiasco, with its shameful history, is fresh in memory on this Coast, and now, only six months behind, the Black Hill's mines are closed down, for good, no doubt. The result of all this, and the loss of more than all the mines and tin-plate factories are worth, is the introduction here of a branch of the industry, unskilled, unhealthy and underpaid work done by foreigners, and of no particular advantage, except to manufacturers of sheet iron.

Industrial Notes.

The *Railway Age*, in a recent issue, describes a method of preventing smoke that is at once rational and cheap. It is in substance, building an open or checker wall of fire brick between the bridge wall and boiler; behind this, a second bridge wall having a perforated top the same as the first wall, providing a second combustion chamber. The functions are to baffle or break up the flames and gases of combustion, and expose them to the highly-heated brick work; first on leaving the grates, and again in the second combustion chamber. The retardation of draught thus caused permits a free inlet of air, both through and above the grates, and a thorough admixture with the hot gases of combustion. The whole structure for a single boiler need not cost more than ten to fifteen dollars, and is well worth a trial in common furnaces, to any of which the method is appliable. Some simple device of the kind that could be specified in law would be a possible advance in smoke prevention acts. The *Railway Age* mentions two cases in large works where these furnaces were applied with success.

On the 18th of January last some experiments were made at Portsmouth, England, by firing 100-pound projectiles against "Harvey plates" that must have been a surprise. The gun and projectiles were the same as are employed in testing armor plates 10½ inches thick, while the Harvey plate was only 6 inches thick. In the first round the projectile was "pulverized" without penetrating the plate. The next round, with 42 pounds of powder, cracked the plate, but broke up the shot without penetration, the velocity being in this case 1,813 feet per second. A third round, with 48 pounds of powder, at a velocity of 1,960 feet per second, the projectile perforated the plate but went to fragments. A fourth round at the same charge and velocity as the first one gave a like result, destroying the shot without penetration. This is a remarkable result, because the resistance of armor is commonly computed as the square of the thickness, in this case as 36 is to 110.25, comparing the Harvey plate to those of common construction. If the facts here given are borne out in future experiments, the admirality will have to adopt the Harvey method of preparing armor.

In South Staffordshire, England, they have constructed an electric railway on the overhead trolley system, that is not only free from the objectionable appearance of lines here, but is really ornamental. There is but one row of poles at the side of the street, two wires being carried on a projecting arm, the trolley staffs or booms leading off sidewise to the wires. The poles are of iron or steel, and as before said, of ornamental appearance. There is but little obstruction to the street compared to the double pole system. This construction is no doubt a little more expensive, but not much, and we fail to see in any case, the force of arguments against the first cost of constructing electric lines, so long as the public are called upon to pay the same fares as on a cable or other railways. Some regulation of this matter of poles is necessary here. If nothing else, the companies should be compelled to take the bark off saplings and perhaps paint them.

The common formula for finding the tractive power of a locomotive, is:

$$T = K \frac{p\ d^2\ s}{D}$$

in which T is the tractive force, p the boiler pressure, d the diameter of the piston, s the stroke, D the diameter of the driving wheels, and K a coefficient of mean pressure, usually 0.65. An engineer, writing to the *Zeitung des Vereins Deutscher Eisenbahn Verwaltungen*, presents a new formula, in which the flexible coefficient K, is rendered constant or nearly so for all cases, that is, for high or low speed and varying admission of steam or pressure. This is done by dividing the results obtained by the formula above by the square root of the number of revolutions per second, represented by N, as follows:

$$T = K \frac{p\ d^2\ s}{D\ \sqrt{N}}$$

In the *Mechanical World*, from which we condense the above, there is given a number of test cases, showing that the results of the last named formula, do not in any case vary more than three per cent. from indicator results.

The frequent fracture of propeller shafts, as in the late case of the *City of Peking*, will be less serious when two screws are employed, as is now becoming common, but there is certainly wide room for some other remedy. The want of larger shafts, and the flexure of hulls, which are set up as causes of fracture, are not satisfactory. There

must be some other cause, and we imagine it exists in the irregular turning moments on such shafts, together with their great length and consequent torsional flexure. It is true the same conditions exist in all engine shafts between the crank and fly wheel, but not beyond, and this distance is very short in comparison with a screw shaft, indeed the difference is so great that the number of accidents are probably in proportion to the exposed length of the shafts. Statistics showing what relevancy these accidents bear to the irregularity of torisional strain, will no doubt bear out the assumption above made, that shafts like deflecting springs, break after a certain amount of molecular disturbance in obedience to some law of which we know very little.

The Midvale Steel Company, at Nicetown Pa., recently cast of steel, for the U. S. War Department, what is called a "chassis" for a gun carriage, that weighs 13,500 pounds. From a photograph at hand the contour and surfaces of the casting seem as perfect as a dry mould casting of iron, but the most remarkable part is that notwithstanding these unusual dimensions the steel was of wonderful quality, showing a strength of 69,000 pounds, elongation 31.60, with an elastic limit of 35,000 pounds. The specifications called for a tensile strength of 65,000 pounds and elongation 20 per cent. Supposing the casting to be as perfect as the photograph shows, it should modify Chief Engineer Melville's views on such castings. The form of the casting may be described as a ribbed plate, or to be more correct, a webbed frame. This casting could no doubt have been made here, and in justice to the Pacific Rolling Mill Company of this City, Chief Engineer Melville should have recognized in his report the successful work of this company in preparing heavy steel castings for the war vessels built at the Union Iron Works.

In a certain machine works we know of, there was instituted at the beginning, some rules of an unique character that turned out well. Four of these rules were as follows: (1) No screws to be used less than ⅜ in. diameter; (2) No deflecting springs of any kind; (3) No screws with slotted heads; (4) No oil holes to be drilled in wheels or pulleys mounted on fixed studs. There were a number more of these rules not now remembered, but we do remember that after some years of experience there was no inconvenience whatever from carrying them out. They were applied to a diversified class of machinery of medium weight. We also know that the work

turned out was of the best. The idea of such rules is a good one. It may not always be practicable to escape expedients not sanctioned by good practice, but to set out for a systematic avoidance of such things leads to reform or better methods. We know of a large factory in Cincinnati, Ohio, where no loose pulleys are permitted, instead of these a second shaft is mounted in line and the belts shifted to that. It was expensive, but the owners claimed that it paid them to follow this method.

LOCAL NOTES.

Mr. Augustus Knudsen, of this City, a civil engineer of wide experience in topographical work, especially in South America, is now preparing a technical essay on "Triangular Surveys from Single Stations." This work will be published soon, and will have no doubt a considerable bearing upon the subject of preparing maps, just now one of interest on this Coast or in this State. In respect to this latter subject, to which Mr Knudsen has given a good deal of attention, he suggests that the preparation of maps of the State should be undertaken just like other business enterprise by an organized and incorporated company, that would contract to prepare maps according to some stipulated standard and subject to the same conditions that apply to other business. This suggestion we think is a sound one, in any case where the "consideration conveyed" can be made subject to some predetermined standard of quality. The work is extensive enough to call for the resources and energies of a corporate company, which could be organized here among men of unquestioned character and ability.

The effciency of elevators in buildings, or in other words, the expense of operating them, is an exceedingly difficult matter to arrive at, because of the irregularity of loads raised and lowered. The number of trips is easier to deal with, but on the whole there is no doubt to be some standards of efficiency for this class of machinery as there is for other motive power. In the Pacific Mutual Building on the corner of Sacramento and Montgomery Streets in this City, some recent observations show that to raise steam in the morning and make 383 full trips of 114 feet, throughout the day of 11¼ hours, there was required 730 pounds of Cardiff coal, or 1.9

pounds per trip, or at $8.00 per ton, about two thirds of a cent each trip for fuel. The elevator machinery in this building is of the hydro-steam type, erected by Messrs. Cahill & Hall of this City, and as we are informed on inquiry, does not embrace some recently added improvements that insure a still greater economy of power or fuel. Modern elevators, with all the improvements of late years, yet lack some features of economy in the power required, but otherwise they seem nearly perfect.

Messrs. Palmer & Rey, of this City, during last month, began sending their gas engines to the Eastern States; 18 to Chicago, 24 to New York, 10 to Omaha, and 10 to Dallas, Texas, in all 62 engines. This is a veritable case of "carrying coals to New Castle," and reflects great credit upon a firm that can produce machinery here at the higher rates paid for castings, supplies, expense and labor. We are not acquainted with the circumstances that permits this reversal of trade, and must accept it as a case of square competition in skill and enterprise. The Union Gas Engine Company are in alliance with the Globe Gas Engine Company, of Philadelphia, Pa., where their various types will be produced at Birdsboro, a works in the suburbs of Philadelphia, where the manufacture of the Clerc gas engine was founded some years ago. The works here are filled with orders for a long time to come. Other makers are all busy, and it is a satisfaction to know that at least one branch of our local manufactures is fully employed.

The report of engineers Manson, Grunsky, and Pierson, to the Sacramento Drainage and Reclamation Convention last month, indicates the extensive nature of any undertaking to conserve the lands of the lower Sacramento Valley. The estimated fund required for five years is $8,000,000 to $10,000,000, and the land reclaimed at 800,000 acres, which is ten to twelve dollars an acre. If the State owned the land and could be recompensed for the expenditure by the increment of value, a system of conservation and reclamation might be expedient, even to the extent indicated, but we imagine that under the circumstances no such a vote of money is probable. The late floods have added something to data already collected, and there is full warrant for arriving at facts as near as possible by a commission, such as has been at work. There is also much need of some kind of public control over levee building to prevent loss and injury that must result from the independent methods now pursued. It is a great problem, now in its opening stage only.

Three years ago, Mr. Hans C. Behr, of this City, arranged a locomotive with the high and low pressure cylinders set tandem at each side, the exhaust from the high pressure cylinder crossing diagonally, so to call it, to the low pressure cylinders on the opposite side. The advantages gained are obvious and important. Now this arrangement appears in a Russian locomotive illustrated in a late number of the *American Engineer and Railway Journal*, and has no doubt contributed a good deal to the convenience and success of the engine described. Mr. Behr's plans were for an urban railway here, and embodied fully the feature above named. We have applied to him for particulars respecting the objects he had in view in this design, and will, if such information is furnished, publish the same in our next issue.

Mr. Watson, of the *Engineer*, New York, has against us the charge of saying he is "nearly" always clear and candid. The adverb is withdrawn. The joke was too subtle. Candor is the chief characteristic of the *Engineer* and its editor, a quality so wanting in these times, and so "expensive" too, that its dispensor must be clad in an armor of truth, and know the ground whereon he stands. Mr. Watson's journal is extensively taken and read on this Coast, and the best apology we can offer for the offense above noted will be to relate a circumstance of recent occurrence here, when one of our well-known engineers was hunting over our files for a reference. He asked "where is Mr. Watsons's *Engineer*, we will get at the 'truth' of the matter there?" Now, what was meant by those words admits of some explanation. There was no question of veracity, but one of understanding, qualified by candor. One who looks through seventy or more serials each month will come to know their characteristics the same as the faces of friends. The *Engineer* on its fortnightly arrival suggests the local salutation — shake!

ELECTRICITY.

NOTES.

Dr. Druitt Halpin, a well-known engineer in London, proposes a novel scheme of adapting the motive power of stations to the wide variations of use that occur in electric lighting. This, as all know, varies in a wonderful degree as the lights are put in use in

the evening. A diagram for December, in Berlin, shows a mean load line of about 2,000 for 7 hours, and a maximum of 7,500. Between 4 and 6 P. M. the rise in resistance or load was nearly 2,000. This matter is, however, too well understood to require comment. Mr. Halpin proposes to employ feeding boilers, worked continuously, at 250 pounds per inch pressure, and through these circulate water to be heated up to 406 degrees and stored in tanks or receivers, from which steam can be drawn to work the engines at 115 to 130 pounds per inch, and at a temperature of 347 degrees. This is a very novel proposition, and possibly one of much importance; to be decided, however, by balancing the losses of irregular steam generation against the expense of maintaining receivers, and their losses. The problem is one that can be dealt with in a tolerably accurate manner by computation, and will, no doubt, be taken up at once for discussion by engineers.

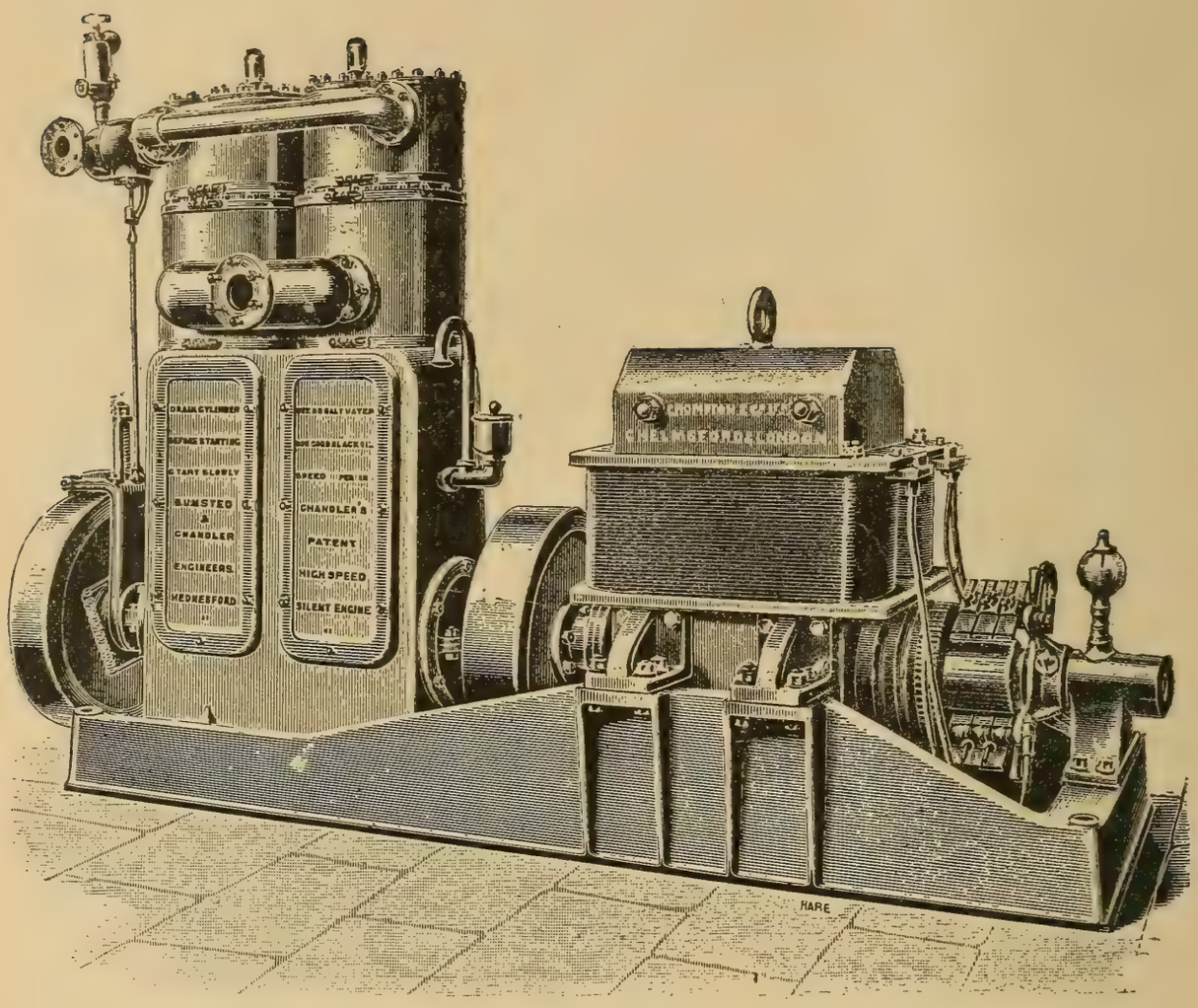
The *Mechanical World*, speaking of the medico-electric appliances, belts and so on, that are advertised, says: "As a matter of fact the so-called electropathic belts and similar goods are really not electrical. They can only give an infinitesimal current, which does not reach the body, and even if it did is so exceedingly slight as to be of no utility. It seems of no avail that medical men have nothing to do with such appliances, or that the deception is exposed." People like to be deluded, or at least like to deal with the mysterious. We may reach what plane we please in scientific research, still there is left a strong trace of the original savage in us that must find vent in small superstitions and respect for the marvelous. Hence the medical profession know the futility of trying to protect people from delusions. It is nearly all wasted effort.

Governor Flower, of New York, in a late message of his, called attention to the use of electric motors for propelling canal boats by means of a conductor strung along the route, as in the case of city railways. The idea is not new and is questionable. Some of the circumstances may favor it, but a good many impediments lie in the way. Trolley contact would be very difficult to maintain, and the difference of speed between different boats another obstacle. This latter seems an insuperable difficulty in the case, because it will be impossible to move boats at a prescribed speed, loaded and unloaded. It is significant too that in countries where there is much more canal traffic than in this one, in France for example, no appli-

cation of the electrical system has been made to canal propulsion. Another criticism to be offered is that the Governor of a State, who is not an engineer, cannot do more than deal with certain economic assumptions that lie very wide of the practical facts in such a case as this.

An important decision was recently rendered in England, involving the patent of Mr. John Hopkinson on what is called the three wire system of transmission. Judgment was rendered against the St. James and Pall Mall Electric Light Company, as infringers, but with the provision that the injunction be "suspended for six months." It is this last named point we wish to call attention to. In nearly all cases a deferred injunction is expedient. It permits an adjustment by agreement, and gives the contestants time to "cool off," so to speak. People seldom infringe a patent openly, unless they believe it to be invalid, or that successful defense can be made, so there is not, as in the common infraction of law, a criminal intent to wrong some one.

A patent has been granted in Germany for an improvement in incandescent or glow lamp manufacture, that will, if successful, reduce in a considerable measure the expense of platinum wire, now used for conductors, because of it being the only metal having the same coefficient for expansion as the glass in which the wire is embedded, also because of a high resistance to heat. The new invention is that of an alloy so compounded as to have the required rate of expansion. A tube of platinum is filled with other metals, iron or nickel and antimony, and the whole fused by an electric current, which welds all together. This tube or bar is then drawn into wire by the common processes. The surface is platinum and the core, as before stated, of cheap metal. The iron or nickel is combined with antimony until the coefficient of expansion is the same as that of glass or platinum. The surface of platinum resists the high temperature incident to fusing the glass. The invention is based on the assumption that the expansion of alloys by heat is as the mean of the coefficients of expansion of the metals of which the alloy is composed.



HIGH-SPEED STEAM DYNAMO.

The above engraving, reproduced from *Industries*, London, shows an example of a direct steam dynamo, the engine being one of the Chandler single-acting type, and the generator one of Crompton's, London.

The Chandler single-acting engine was one of the earliest, following close after that of Herman Westinghouse at Pittsburg, and the Willan engine at London. It has been a good deal changed, the valve details wholly, but the main feature of extreme high rotative speed remains, or has been increased. In the present case the initial cylinders are 8 inches diameter, the low pressure 11 inches, and the speed 425 revolutions per minute.

The dynamo is 110 volts, 40 amperes, at the speed above named. The design, as a whole, is uncouth, and could, as we think, without loss be converted to a more symmetrical form, especially the engine

and main frames, which present an appearance of being nailed up out of boards.

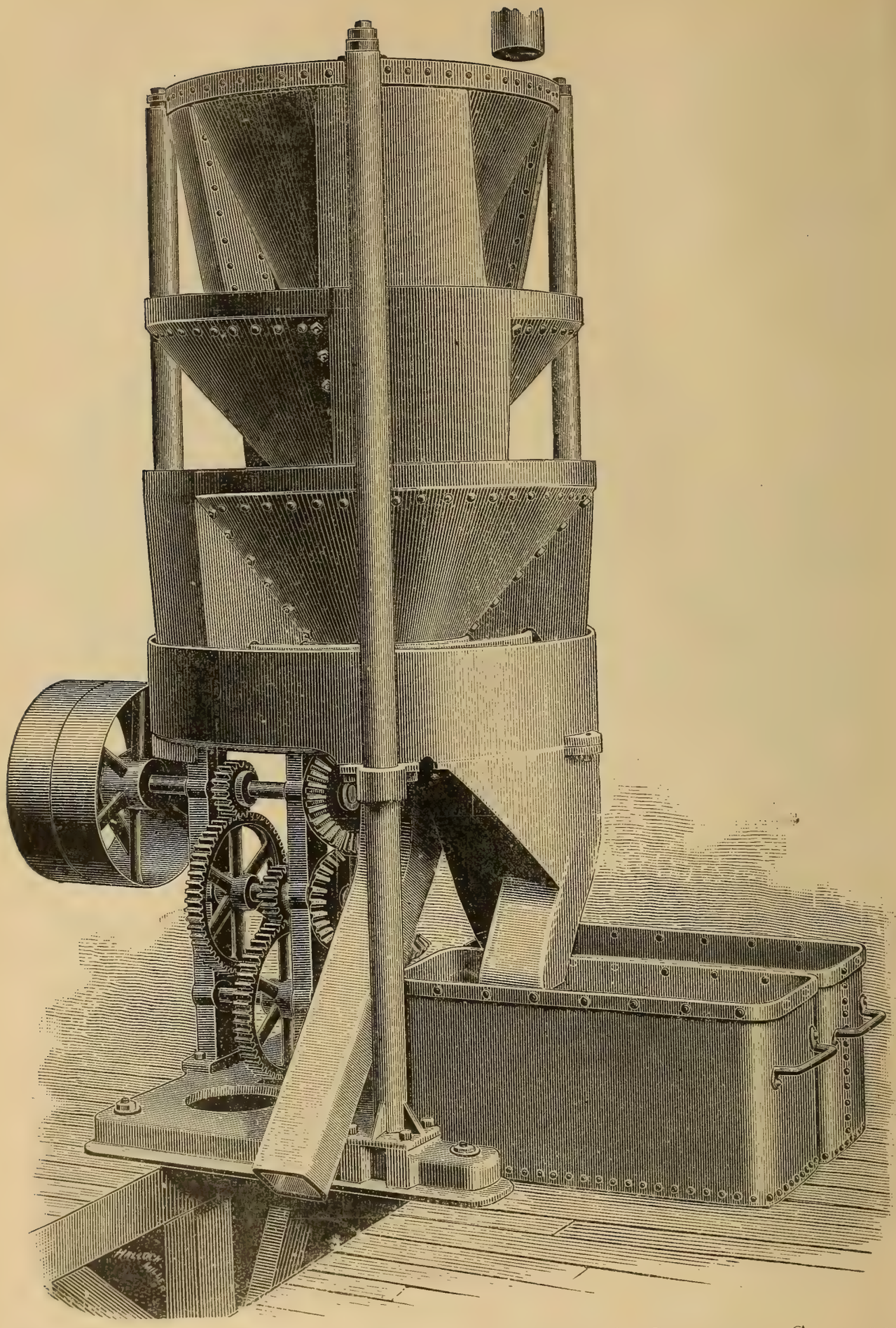
It is not unusual in machine frames to see the carpenter form of castings, generally designed by pattern makers or others accustomed to woodwork. The idea of fiber in "one direction," which characterizes all forms of woodwork, has no application to metals, but, the type is carried over insensibly sometimes.

MINING.

NOTES.

The shares of the Ontario Mine, in Utah, fell from $40 to $16 when the dividends ceased in November. The product of the mines being consumed in making a draining tunnel five miles long, which at $10 a foot would cost a quarter of a million or so, one fiftieth of the amount the mine has paid in dividends. There is also in preparation, plans for a large leaching plant that will add a good deal to the outlay for the coming year. There is plenty of ore in the mine, if reports are true, and it is hard to account for the shares falling off in value as above stated. The fall in silver has something to do with it no doubt, but the cost of producing at the Ontario Mine has been such that the price of silver alone, while it might diminish dividends, would not sink shares from $40 to $16.

Reports from Virginia last month say that only 70 stamps are running on the whole of the Comstock Lode, and that not more than 140 miners are at work in the district. This is representative of the State, perhaps not in proportion, but in general, and is most unfortunate for Nevada. *The Engineering and Mining Journal*, for Feb. 11, foots up the dividends for 29 of the principal paying mines in various parts of the country at $1,015,900, an insignificant sum when compared with what a single district has turned out in times past. The Kennedy mine in Amador County is among those working at a good profit, having returned $68,000 during the last month of 1892, the largest amount on record for that property. A large amount of mining machinery has recently been shipped to Ecuador from this City, to the order of owners in New York.



BRIDGMAN'S ORE SAMPLING MACHINE—FRASER & CHALMERS, CHICAGO.

BRIDGMAN'S ORE SAMPLING MACHINE.

FRASER & CHALMERS, CHICAGO.

We have received from Messrs. Fraser & Chalmers, Chicago, a copy of their descriptive circular, or rather an essay, on ore sampling machinery, also the drawing opposite and the following special descriptive matter relating thereto.

"The engraving opposite shows a new automatic ore-sampling machine, invented by H. L. Bridgman, made and sold by Messrs. Fraser & Chalmers of Chicago. One of these machines has been very profitably employed at the works of the Chicago Copper Refining Company., Blue Island, Illinois, for the past two years.

The matte and ore are unloaded by hand from an ore car on a lower level, which runs by tramway over platform scales, and thence by platform elevator to the crusher floor, where it is dumped, and the contents are shovelled into a crusher of large capacity. The crusher discharges directly into the large sampling machine, of which we show an illustration. In passing through this machine the fall of the ore is partially intercepted by three revolving apportioners. The uppermost of them separates two parts of from one half to one eighth of the whole lot, according as it is adjusted. These parts are successively quartered by each of the lower apportioners, a division cleverly accomplished at a desirable low speed, by giving each of the lower ones three times the revolutions of the one above it, and causing the middle apportioner to revolve in the reverse direction, which is equivalent to quardrupling the revolutions of each successive apportioner.

The bulk of the material as "discard" is then automatically received into an elevator, lifted, passed through crushing rollers and screens, and finally delivered to bins, ready for roasting, while duplicate samples are delivered from the sampling machines for assaying. This whole work, from the railroad car to the bins, costs only 24 cents a ton, and that at a liberal rate of wages, and including the services of a foreman and weigher, the cost of the sampling proper is less than 3 cents a ton.

The sampling begins simultaneously with the unloading of the car, and is finished, the machine cleaned (occupying about fifteen minutes) and the samples delivered to the assayer within half an hour after the completion of the unloading. Forty thousand pounds per hour, of material crushed to about ¾″ to 1″ size, is found to be within the capacity of the machine.

The space required for sampling at these works is only ten by twenty feet, and at the works of the *Cia Metalurgica Mexicana*, (San Luis Potosi, Mexico,) the use of one of these very compact and effective sampling plants enabled the management to omit a 60 × 100 foot building from their plans.

The sampling is found to be accurate, when tested by the most careful hand sampling, and with the check of duplication, and this with the freedom from the possiblity of hand tampering, leaves little to be desired. Even if the feeding is irregular, the samples are so made up that very trustworthy results of the average character of the ore are secured. The portions of the material which are finally delivered as finished samples must have passed through the machine without having been treated by it to any appreciable extent, thus making it impossible for any segregation of coarse and fine to occur; the material in the sample buckets is necessarily of the same constitution as when it left the feed spout. The machine samples either fast or slow and treats equally well all the different materials, from flue dust to granulated copper carrying 1,000 ounces of silver to the ton.

Following is a characteristic test. In the table, *A* and *B* are the results of assays of machine samples of a load of copper matte, (weight 47,791 pounds, car No. 5416) samples weighing from 600 to 664 pounds. *C* is their average. *E* and *F* are the results of duplicate hand samples carefully cut out from the "discard" of the machine, the samples being originally 4,800 pounds each, and cut down in 2½ hours by two men to approximate sixteenths, weighing from 329 to 352 pounds. *G* is their average.

	Oz. Au.	Oz. Ag.	P. Cu.
A	0.25	69.6	62.4
B	0.25	69.9	62.3
C	0.25	69.7	62.35

	Oz. Au.	Oz. Ag.	P. Cu.
E	0.25	68.7	62.4
F	0.25	68.9	62.4
G	0.25	68.8	62.4

The value contents of this and one other car (No. 5385) which sampled together by the shipper are shown in *H*. By machine sampling the value contents were found to be as in *K*.

	Oz. Au.	Oz. Ag.	Lbs. Cu.
H	9.439	3289.46	58852
K	11.799	3295.31	58875

The best results for very rich ores may be obtained by so adjusting the upper apportioner as to take out larger first samples if desired, dividing the whole lot into two parts by the first apportioner and passing the large samples from the first machine through a second machine. For such secondary sampling a smaller machine is especially designed, not producing duplicates, and this should be a part of the regular sampling system for rich ores.

There is thus a great convenience of close results readily obtainable, and checked by a system of double sampling which may be compared with double entry book keeping. Also the very great saving in labor and building space, which makes the use of these machines a valuable economy where clumsier and less reliable apparatus are comparatively extravagant at any, or even at no first cost. These machines have been offered for sale only a few months, but quite a number are now in use in various parts of the world, and others are being made. A very complete exhibit is being prepared for the World's Columbian Exposition at Chicago."

FOREIGN TRADE.

Among a large part of our people there is a general conclusion that the late election will cause a check of industrial investment, and among those who think most, there is also an opinion that such a check is expedient and desirable.

Under an artificial stimulation, people have rushed into new manufactures and extended old ones, until the competition in the home market, has in some cases, depressed the prices of products below their cost, and has led to the formation of trusts and combinations that are not only unpopular, but unjust. In many cases prices have been upheld at home and reduced greatly upon such things as could be sold abroad, a kind of discrimination as repugnant as it is unpatriotic.

The value of manufacturing stocks has been depressed to such an extent that for a year passed it has been difficult in the great money centers to raise capital at reasonable rates to be put into manufacturing enterprises of any kind. This has been especially true of New York, but has been general and extensive. The fact is we have been for some time past, rapidly nearing a culminating point in this craze to manufacture, and the present halt will do no harm. There are those of course who see prosperity in everything new that is proposed, no matter if it succeed or not, but anyone who has observed the effect of failures must admit that it is much better to do without ten manufacturing establishments, than to have one founded and fail.

It is perhaps asking too much of our friends of the dear school to admit at the present time that stagnation of business and the competition in the home markets is because of a want of other markets, but this is certainly true. Our trade has been choked and hindered by an inflated cost of raw material, and a spirit of contention that has shown itself in retaliation and reciprocity, a kind of provincial policy not becoming in a great nation of sixty-five millions of people. There has been and always will be in all countries, a good many people who are incapable of understanding the effect of a wide and diversified market, and who can see nothing beyond their immediate environment; to whom a market not secured from competition by some kind of monopoly and force, is no market at all, and to whom spasmodic and speculative business is preferable to stability with low and constant profits, such as would result from

an extended foreign market, permitting an output year by year of nearly the same amount.

Such views of business are growing less common, and people are beginning to realize that spasmodic business is not desirable ; that every "boom" brings a corresponding depression, and that individual prosperity depends upon general prosperity. So interwoven and connected are the wheels of industry, that the whole must move together, and this cannot be the case when the people of a country are contending for a home market, one man gaining what another man loses, breeding distrust, deceit, and schemes that array one part of community against another.

The beneficient influences of a foreign market and its effect upon industrial affairs can only be understood by some experience in this kind of trading, or in observing such trade when it is extensive enough to modify the industrial affairs of a country. Instead of schemes to outwit and press down one's own countrymen, it begets a community of interest, creates friendship and relations that cannot exist when the home market is contended for like hungry dogs fighting for a bone.

The greater share of American products have preference in the neutral markets of the world if offered under the same circumstances as like goods are from other countries. By circumstances we mean prices, carrying facilities, banking arrangements, credits, and above all, what may be called adaptation to the wants and tastes of foreign consumers.

Our manufacturers and merchants have been so long dealing almost exclusively in the home market that they have not learned a great deal it is necessary to know in foreign trading. It requires a good deal of philosophy on the part of anyone to avoid that besetting sin of people measuring and judging everything by local standards and customs.

Almost everyone on a first visit to other countries begins by assuming, mentally at least, that whatever differs from what they are accustomed to is wrong in the same degree. After a time, however, this habit wears off, and a better standard is set up, or rather standards are abandoned for a state of doubt, and finally an impartial or, as we may say, a cosmopolitan view is taken. This is the key to successful foreign commerce with people having dissimilar customs and wants.

In this matter we, in this country, labor under peculiar disadvantages because of isolation. People are apt to forget that we are set

off many thousands of miles from any other nation of a similar civilization and pursuits. In Europe there is at one's elbow, so to speak, other countries on all sides. Their newspapers are read within a few hours of publication each day. Their people are intermingled, and, by an association we have not at all, there is a diffusion of knowledge that promotes trade. The markets of one country react directly upon the markets of another. Competitive bids go out the same day from England, Germany, France, Belgium, Sweden and elsewhere, uniformly conforming to requirements in even the most remote countries. This we are not able to do at this time, at least not in a degree to permit fair competition, but the time has come to begin a careful study of these matters.

Another impediment, besides a want of our own carrying facilities, is the lack of shipping firms, acting also in the capacity of agents or "factors". Shipping goods within the United States is a simple matter if we except the fact that the railways do not take up or deliver goods and a drayman has to be sandwiched in between the shipper and consignee at the two ends of the route. There is nothing to do but to mark, deliver and take receipts for goods, but in foreign shipments there is a good deal more to do, so much indeed that it is not common in Europe for a manufacturing firm or company to undertake this work. They prefer to pay a small commission to a shipping house who are skilled in the business, and know all the routes, requirements and rates all over the world.

There is also another function of these shipping firms of even more importance, that of agents for foreign clients. Suppose, for example, a San Francisco firm wants to purchase in Europe machinery, metal or any other commodity. Applying our methods, letters of inquiry would be written to various firms producing the articles wanted. This would be irregular, also injudicious. The proper way would be to address a shipping firm who would select the goods wanted, make contracts for them, inspect, receive and ship the goods as the agent of the purchaser. Such firms require a standing far above question or suspicion; also large resources, but there are plenty of them, and we must have the same thing here before there can be much expansion of our foreign trade.

We have such firms now, but not many, and the nature of their business is not well understood. One of the largest firms in England, Messrs. Tangye Brothers, of Birmingham, had formerly a rule that "salt water should not intervene between them and their goods." This meant that all foreign orders were turned

over to merchants or shipping firms, and not filled directly. An example is that of Baring Brothers, known here as a great banking firm, but in the London directory they will be found listed as "merchants," which they really are. They deal in bills of exchange, stocks, locomotives and bar iron.

These hints, imperfectly presented, are gathered from some experience in international trade and observations thereon, in several European countries, and may have some application in the near future, when it is believed a more extended knowledge of foreign trade will be needed and sought for.

THE NORTH SEA AND BALTIC CANAL.

The acquisition of the Danish provinces of Schleswig and Holstein, by Prussia, are events well remembered by middle aged people. It gave to Germany a much wanted inland protected naval station at Kiel, on Kiel Bay, a landlocked inland sea opening out into the Baltic Ocean, not reachable except by sailing around Denmark, a distance of a thousand miles or more from Hamburg, Bremen, and the principal ports on the German Ocean.

Holstein stretched up in a provoking manner nearly to Hamburg, and on the very extreme, three miles away, from the "Alster" was the City of Altona, now merged into, and with St. Paula, forming an integral port of the great German commercial metropolis.

The River Elbe, from Hamburg down, widens into an estuary, and at 50 miles is ocean. The canal begins at Tonning, on the Elbe, and extends to Kiel, on the Baltic, a little more than 61 miles. The canal across this peninsula is to be, on the bottom, 72 feet, at the water surface 190 feet, and 27 feet deep, and its completion is set for 1895.

To understand the importance of this water way one requires some experience of navigation in that country, or, rather, over the old route around Denmark, through the Kattegat, and the straits between Sweden and Denmark, only three miles wide at Elsinore, where the Royal Dane took his ghostly walks. This name is, however, not "Elsinore" but Helsingör, which is a very different kind of name, "Helsa" is health, ö is island, and ör the plural, so that Helsingör becomes "Health Islands" in Scandinavian.

On the opposite shore, in Sweden, is Helsingborg, or "Health Castle" or fortress, so the two names sound much alike. These

narrow straits are a great impediment to commerce. Sometimes, in adverse wind, a thousand vessels will be assembled there waiting to pass through. "Tull" or toll was levied there by Denmark down to recent times when the straits were freed by an indemnity paid by the principal commercial nations interested. This is the door, or gate, to the Baltic Sea, and Russia's only outlet to the Atlantic Ocean. But this narrow door is not the only impediment to navigation in reaching the Baltic. In summer these oceans are peace—like a lake. In winter they are boiling cauldrons, swept by storms, filled with ice, and chilled by low temperature. We have been on a strong steamer that was nine days in going from Gothenburg to London, 600 miles.

The gulf stream, in its erratic wanderings, switches around the sandy coast of Gotland, near enough to raise clouds of fog in the winter that cover the "Skager Rack," the great estuary north of Denmark. Vessels have to proceed by soundings. There are no observations, not even dead reckoning, but feeling the way with a chance all the time of mounting a sand spit to remain until next summer, or forever, the latter generally.

Through this narrow gate to the Baltic, passes each year, 40,000 vessels. The average between 1871 and 1880 was 35,246 a year, and is at this time about a hundred each day, but as navigation is practically closed in winter the number passing in summer months is at least 150 a day. The whole number of ships passing into the Baltic at the present time, by the Straits, the two Belts and the Eider Canal, in Germany, must be not far from 50,000 a year.

Of this vast commerce nearly all will go through the North Sea and Baltic Canal if the tolls are so adjusted as not to be a burthen, and of this there is no danger. The German government is constructing the canal, and even if it were not, would take good care to see that no syndicate, or company, interfered with the common good of the Empire.

If the reader will take a map of Germany and draw a straight line from the nearest point on the Elbe River to Kiel, it will not much exceed 50 miles, but the line of the canal, as before remarked, is 61 miles long, because of detour by Rendsburg, so as to utilize the waters and work of the Eider Canal. This is an economic expedient of much importance, because one of the first things in constructing a great canal must be a temporary line of railway, or canal, for purposes of transportation, and as the Eider Canal is already made, and the northern part of it will be useless when the

great canal is done, there is every reason, beside grades, for selecting the old route.

Going down from Altona to Kiel, by railway, one gets an idea of the country. The proverbial mud fence is here as a fact. It is a grazing and agricultural country with much marsh or moss lands. This is a difficulty met with in constructing the canal. The filling in of Chat Moss, by Stephenson, when he constructed the Manchester and Liverpool railway, was a new and wonderful feat at its time, but the same thing is done in the Holstein marshes to support a canal, which if above the marsh level, would be ten times as heavy as a railway and its traffic.

The Russian ports send the largest quantity of freight out of the Baltic Ocean, 4,611,570 tons. The Swedish ports furnish 4,031,821 tons a year, taking an average over nine years. The number of vessels expected to pass through the new canal is 27 steamers and 90 to 100 sailing vessels daily. This seems impracticable, and is so, if there is not width for through double traffic and no detentions.

There will be in the construction of a canal across Nicaragua a good many circumstances like those existing in the Holstein peninsula, and a good deal to be learned no doubt, from experience there. The English engineers, in constructing the Manchester Canal, had recourse to German machinery and methods of moving earth, especially in respect to chain or ladder dredging machines, and this part will, no doubt, be very successfully conducted on the Baltic and North Sea Canal.

COMPOUND PUMPING ENGINE.

[See Frontispiece]

The plate forming the frontispiece in the present number, illustrates a new form of pumping engine, by the Groshon High Duty Pumping Engine Co., of New York.

Some indicator cards accompanying the printed data received from the Company, show a curve or rate of expansion that is remarkable for a direct-acting engine, corresponding to the best results attainable in the high-class steam engines of the common type. This is accountable for by features of construction and operation that we will briefly point out.

The valves of the steam engine, and their main actuating gearing, will be understood by those familiar with the Corliss system, which is here carried out, except that the point of release or cut-off

is not a function of speed, but of water pressure, hence is more simple in so far as operation than if controlled by a centrifugal governor, while steam distribution is the same or even more complete. Of this matter, Mr. Groshon, the inventor of the engine, writes as follows:

"The Groshon Engine is the only direct-acting one now in use that works steam expansively and has automatic release valves, thereby enabling the engine to adjust itself to any varying condition of steam or water pressure. The automatic release, as you can see, is a very important matter, as it permits us to ruu the engine with the throttle valve wide open at any rate of speed; consequently perfecting the well-known Corliss principle of release valves."

Referring to the drawing, the links and cranks above the valves show the trip or release gearing. This is connected by the vertical rod shown between the engine and pump, to a piston subjected to and adjusted by the discharge water pressure, so the point of cut-off follows closely and absolutely the variations of resistance to the engine, irrespective of speed or boiler pressure, when once adjusted to any desired rate of movement or duty.

The compensating devices are analogous in nature in so far as deriving their force from the discharge pressure. The principle, to so call it, is that of proportioning the discharge of water to the effective pressure of the steam throughout the stroke. The compensating force to supplement the fall in steam pressure due to expansion, is an auxiliary pump or cylinder, which at the beginning of its stroke adds its duty to that of the main piston, the discharge then being equal to the capacity of both pumps or pistons. As the steam pressure falls off, the movement of the auxiliary pump diminishes accordingly, until it not only ceases, but begins a reverse stroke, and absorbs in part the displacement of the main piston.

Another method of explanation will be to say that the discharge force of the water is employed as a "spring," which is compressed at the beginning of the stroke and expands to give out its accumulated force toward the end of the stroke, compensating or supplementing the falling steam pressure due to expansion. This will be understood from the drawing, by explaining that the vertical link seen near the end of the main pump is connected to the piston of the auxiliary or compensating cylinder, which is placed vertically.

This latter pump, to so call it, has no valves, is merely a cylinder and piston with the force of the discharge water resting on one side of the latter. The rest of the mechanism is easily followed out. The levers in front connected to the cross-head, are arranged to

distribute this pressure so it will conform to and supplement that on the main steam piston, as before explained. The somewhat complicated functions of this compensating piston are strangely derived from mechanism so simple as to almost constitute an anomaly in machine action; the elements being, as before stated, a simple reciprocating piston sustaining on one side the constant pressure of the discharge water.

GOVERNING ENGINES BY INERTIA.

Previous to the advent of electricity as an element in our industrial and social affairs, the methods of speed regulation for steam engines met the various requirements in a fairly satisfactory manner, but electrical generators imposed new requirements, and set the mechanical world to work to invent or discover means of "closer regulation," as it was called.

Balanced valves that moved with but little resistance, permitted centrifugal weights to be attached directly to the eccentrics of the automatic class of engines, as such weights had previously been applied to the detachable type of valves, and in this manner regulation was secured within a margin of two or three per cent. of variation. The most important exception to these means of regulation was invented here in San Francisco, some ten or twelve years ago, by someone whose name we cannot recall at this time. It consists in mounting the main driving wheel or pulley loosely on the engine shaft and driving it by means of yielding springs attached to the shaft, or to a fixed wheel or pulley thereon, the springs so arranged as to be compressed or extended to a certain limit with a given resistance on the wheel, or by its inertia. In this manner the slightest change of resistance, or change of speed in the engine, at once moves the loose wheel and crank shaft relatively, and acts on the point of cut off in the usual manner.

The latest invention, said to maintain the speed of an engine within one per cent. of variation, is in many respects the same thing, a counterpoise or weighted lever mounted loosely in the driving pulley or wheel, propelled by the strain of centrifugal weights, instead of a spring, or rather is a spring produced by centrifugal action. The eccentric is mounted directly on this pendulous lever, so the action on the valve is a resultant of inertia and centrifugal action combined.

THE TECHNICAL SOCIETY OF THE PACIFIC COAST.

The Technical Society met at their rooms, 819 Market St., on the third day of last month. Several new members were elected, and two applications for membership were received.

Mr. J. L. Maude, C. E., of Riverside, Cal., who was present, contributed a paper on the "Duties of County Surveyors," with a suggested Legislative measure to regulate and define such duties. The subject was briefly discussed, and a committee named to farther consider it in future and report.

Prof. Willard D. Johnson, of the U. S. Geological Survey, read a paper upon, and explained in an address, "The Plane-Table Method in Topographical Work." The methods of topography seem just now to be a fertile field for discussion, and there is no doubt that there has been too much conservatism in the past, and much room for innovation in such methods in future, and it may be suggested that, while considering the plane-table system as developed or improved by Professor Johnson, it would be well to include in, or follow the discussion by some consideration of Mr. Knudsen's scheme of "Triangulation from a Single Station." The subject is one directly of the nature that comes within the province of the Technical Society to investigate, if not followed out to acts of Congress or Legislature, which is another branch altogether.

At the next regular meeting, on March 3d, Mr. J. B. Crockett, of this City, President of the San Francisco Gas Light Company, will present a paper on "Experience with a Twenty-four-Inch Gas Main." This paper will no doubt contain a great deal of very practical information of interest to the members of all professions.

THE AMPUTATION REMEDY.

There is a subject, and a very important one, in connection with machine industry, that could with much profit be more widely discussed in technical and trade journals. We allude to the treatment of hurts and wounds, especially such as so frequently occur to the fingers, hands, or arms of those engaged in the care and manufacture of machines.

Such a department has been for some time maintained in the *Railway Age*, by Mr. W. H. F. Miller, surgeon to the Chesapeake & Ohio R. R., who, in a recent article, says:—

"There are several points which I wish to impress on railway surgeons, and the first is the wonderful recuperative or healing power in the extremities. We are often called on to look at a "mashed" finger, hand, or foot. At first glance there seems to be no hope of saving the member, and we are prone to amputate. Always look twice or three times, and as long as there is the least chance of any circulation, either direct or collateral, try to save the member."

The mercenary, or unskilled, surgeon, for there are such in this profession that almost alone maintains a true ethical position, always decides on amputation when there is colorable excuse, and it would be no stretch of truth to say that in at least one half the cases where fingers, legs, and arms are amputated, they could be saved, by proper skill, without endangering life. Of course the safe, and at the same time cowardly course is to amputate. It saves the risk of blood poisoning; is much easier than patching up a mutilated member, and as evidence of a more skilled treatment is destroyed when amputation is made, that is the course pursued, or, at least, is too often pursued.

A surgeon is taught, in clinical lectures, how to cut off limbs. The operation is analogous in all cases, and amenable to rules, but to rearrange lacerated parts, crushed fingers, or broken bones is another thing. In technical parlance this is "special work" calling for original judgment and high skill.

These remarks are suggested by some cases treated by a skilled surgeon, in this city, whose name we are not permitted to mention. He has devoted special study to "saving" instead of amputating, and the results, many of which are shown in photographs, are amazing.

A charitable lady who had occasion recently to call in the services of this surgeon, was so impressed with his skill and methods, that she presented him a sum of money to be expended, at his pleasure, in treating poor and unfortunate people. The amount was afterwards doubled, and should be made a permanent fund.

Coming now to the practical point of this article, there is hardly a month passes, in a large works, without some one being wounded and requiring surgical aid. In such cases employers, as a rule, think their obligation discharged, for the time, by hurrying the sufferer off to the city hospital, or to the nearest surgeon. This is not enough. The owners, managers, and foreman in a works are apt to know when a limb, hand or fingers are so crushed or mutilated as to require amputation, and when there are chances of

saving them, and should see that amputation is made a last resort, remembering always that nature's recuperative power is far beyond inference and expectation.

In every works there should be at hand the address of some skilled surgeon, and instructions given that in case of accident he should be called in, or, in other words, all large works where men are exposed to accidents, there should be an appointed surgeon, as there is in some of the largest works in England, where there is a resident physician and surgeon on the premises, paid partly by the firm, and partly by the men, and whose services extend to the families of all those employed in the works.

INDIA RUBBER BEARINGS.

A patent was recently granted, in England, for machine bearings composed of paraffine wax, India rubber and bitumen, combined at a suitable temperature. The paraffine 10 parts, bitumen 1 part, are combined by digesting them in a "vulcanizer" at 300 to 400 degrees of temperature. The temperature is then lowered to 200 or 212 degrees, and two parts of India rubber added. This compound, it is claimed, is water-proof, very tenacious, a perfect insulator, and not susceptible to oxidation as India rubber is.

Supposing the qualities are as claimed, and four fifths of the mass to consist of commodities costing less than one half as much as India rubber, the invention is one of no little commercial importance.

The search for compounds constitutes in some respects a distinct branch of invention, or discovery rather, because the term invention, in its true sense, does not apply to such cases. Chemical results are tentatively arrived at, and primarily the result of experiment. The processes of research do not admit of inductive treatment. The reactions and combinations of natural elements, although set out in precise formulæ so far as known, have been empirically derived, and for that reason there is always promise of new results. The scarcity or high price of India rubber, and its multifarious uses in the arts make its substitutes a fertile field of experiment, but it has this far been almost a barren one.

The consumption is enormous. From Para, in Brazil, shipments to the United States are over 8,000,000 kilograms a year, worth

about one dollar per kilo. According to Consular reports from Guatemala, the exports to the United States from there are about 130,000,000 pounds a year, worth fifty cents a pound, making from these two countries alone over $75,000,000 worth of India rubber annually imported into this country.

IRRIGATION IN INDIA.

To read of irrigation in India one is impressed by the possibilities of the system, and by the enormous works that have been carried out there. In an essay on the subject, by Mr. A. T. Mackenzie, C. E., in *Engineering*, London, he gives an aggregate of the areas artificially watered, at twenty millions of acres. These works have been carried on by the Indian Government for forty years past, and were commenced as a provision against famine in that country, but now are extended for the purposes of profit, and are remunerative in the highest degree. In two cases, mentioned by Mr. Mackenzie, there was paid in 1889 dividends of 11¾ per cent., and in another case 25½ per cent.

The main purpose of the article is to describe certain irrigation works, especially an enormous dam on the Periyar River in the Madras district, constructed under great difficulties, such as inaccessibility, malaria, and the danger of wild beasts, especially elephants, which had to be frightened away by fires and drums during the night time. The dam is 2,900 feet above sea level, 173 feet high, 138 feet thick at the base, and 5 feet at the top. The material used was 25 parts hydraulic lime, 30 parts sand, and 100 parts of broken stone. The material was transported a long distance by ropeways three miles long, the power being derived from water wheels. The dam impounds 13,300 millions of cubic feet, a quantity too great for tangible conception. This water is led by a tunnel into a different valley from the one in which the river flows.

One, in reading of these works in India and considering the long term of peace and the absence of famine there, must conclude that the common opinion of England despoiling India is a mistake. The railway lines and irrigation works owned by the Indian Government have supplied elements without which the country would have neither stability nor security.

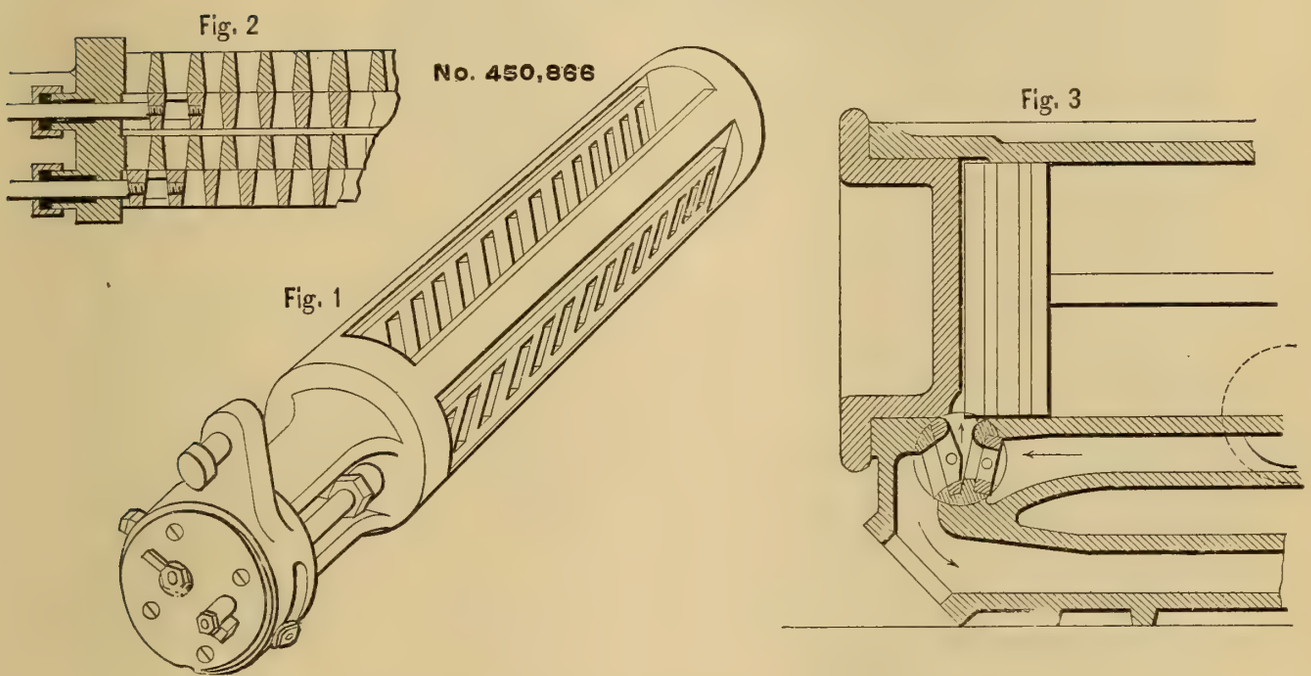
NOTES ON NEW AND PATENTED INVENTIONS.*

BY J. RICHARDS, IN CASSIER'S MAGAZINE

No. II.

U. S. Patent No. 450,866, April 27, 1891.

E. K. Hill.—Steam Engine Valves.



This invention having been illustrated and described in a public way, and in use, is perhaps, a reason for not noticing it here, but what may be called "departures," in the mechanism of steam engineering are not plentiful at this day, and when one is arrived at it deserves to be as widely noticed as possible.

The patent, above named, is called an improvement in "valve mechanism for steam engines," and relates mainly to the combination of the induction and eduction valves within a perforated cylindrical shell called, in the specification, a "skeletonized plug," in the interior of which is formed the valve seats, these being of the multiported kind commonly called "gridiron," because of the bars and perforations. The cubic space occupied is reduced in cross section to small limits, as seen in the drawing, and the whole has the contour of a cylinder. Two of these are inserted, one at each end of the engine cylinder, in the manner shown in Fig. 3.

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Fig. 1 is a perspective view of the mechanism complete, Fig. 2 is a partial section transverse to the ports and the flow of steam. Both the inlet and exhaust valves face one way, and the flow is indicated by arrows in Fig. 3.

We are informed there have been some clumsy attempts to insert valves in this manner before, but not in a form to be considered as an anticipation of Mr. Hill's invention, which, as before remarked, constitutes a departure in engine construction in so far as any common practice that has preceded.

The clearances are moderate, and the functions of the valves are complete, while the construction permits excessive port area, notwithstanding that both the inlet and exhaust valves are within the dimensions of the small containing cylinder or frame. The insertion and removal of these valve cases from the cylinder will involve a problem in the case of sea service, but not, we imagine, for land service where there is no exposure to salt.

The slide valves will meet with approval from the majority of engineers in this country at least, and is in the line of good, if not the best practice of our day, if we include in this remark the curved faces of oscillating valves, which are in effect the same thing as flat ones in respect to endurance and the somewhat obscure conditions that preserve valve faces.

The valve stems can be operated by various kinds of mechanism. That shown in Figure 1, while it permits almost any kind of movement for the two valves, and releases variably the induction ones, is open to the charge of being "trappy," and we doubt if it remain long an integral part of Mr. Hill's valve mechanism. The movements are attained by spiral slots in the outer oscillating shell with pins or studs having rollers fitting in spiral or cam grooves. This involves "hair line contact" of bearing surfaces under considerable pressure, which is a serious infraction of the rules of bearings, also of direct strain, because of the overhang of the studs.

Perhaps the main feature of the invention is an economic one, in the fact that it reduces engine valves to a manufacture, and by a greater division of labor—system of labor it may be called — secures in this part of steam engines an excellence of fitting and quality not attainable when valves are made at the same time with engines. How this will be received by engine makers remains to be seen. There will be much prejudice against purchasing that part of engines which more than any other is an exponent of quality — their valves and the operating mechanism connected therewith.

One maker, an eminent one, said recently in respect to the system, that "when he had no more to do with valves than bore a couple of holes in the cylinder, he would quit the business." This is, however, no argument that will last, and a preference on the part of buyers of engines would soon overcome the prejudice of makers.

It is not long since the same thing occurred in respect to engine governors. They were set off and became the subject of an independent and organized manufacture. For a time engine makers felt that this was an infraction of their rights, and a reflection on their skill, but sentiment is a weak power opposed to economy, and when the cost of a governor became half as much, and the quality of its fitting twice as good, no one except the regular manufacturers thought of constructing governors.

There is every probability of Mr. Hill having hit upon the leading features of what may become a manufacture of engine valves, if such a manufacture is to be, that is, a complete self-contained set of valves to fit into two bored seats that may be prepared from standard measures, and without other dimensions of accuracy to be attained by engine makers.

Connecting rods seem also to be a detail that could become an article of standard manufacture, because of the saving that could be effected by special tools not possible in a common machine works. Something has been done in this way for the smaller and cheaper kind of connecting rods, but the scheme does not seem to have succeeded well.

The Salford Rolling Mills, in England, began the manufacture of steel snap rings for piston packing, about fifteen years ago and, as we believe, have succeeded in founding a permanent trade. The rings were prepared by processes not commonly known, if known at all, outside the works. The section was parallel, with the inner edge rounded, and the bars had the appearance of being "drawn."

Some experiments with them in this country led to an opinion that their exterior or wearing surface was not true, and required grinding to produce a fit. Pumps, condensers, lubricating fittings, safety valves, and even pulleys and wheels, have left the engine shop for the manufactory, and now the distribution valves are threatened with a like fate.

It is an age of manufacture, and struggle for cheapness, or rather a struggle for existence amid competition, but the incentives and aims that govern this phase of modern industry are by no means so important a matter as the effect on use. This is the true economic

measure of the methods of production. If by organized labor a steam engine can be reduced one half in cost, the use of engines would be much increased, perhaps in inverse proportion, but at any rate the effect on power-using industries would be a fact in proportion to which the change in engine making would be an economic trifle. Babbage's *Economy of Manufactures*, written in 1832, should suggest to some one the value and importance of a similar treatise at this day, now that data is abundant. It is not a flattering view of our time and pretensions, but it seems no one is able to discern a philosophy of manufactures as he did, or is capable of generalizations, then difficult, but now easy.

U. S. Patent No. 479,456, July 26, 1892.

O. B. Peck.—Centrifugal Ore Separator.

The specification of this patent as well as a good many others indicates the very wide latitude permitted to inventors for setting forth their improvements. It is not easy to find perspicuous terms to describe inventions, and as specifications are often drawn by those not skilled in the technicalities involved, one need not wonder at some ambiguity, but certainly there are no reasons why the "arrangement" of specifications cannot follow some uniform plan.

In the first place the three primary clauses of a specification should conform to the heads, "relates to" "consists in (or of)" and "its objects are." This is the declaratory part, and in importance ranks next to the claims, because of disclosing the class, nature and objects of the invention, as the inventor understands it. The descriptive portions are to show the manner of applying or using the invention, and, in a sense, are unimportant compared to the declaration and claims. In the present case the specification begins with a description of the mechanism, referring however to a previous application, in which no doubt the nature of the invention is more fully set forth.

The purpose in referring to the present patent, is not to comment upon the substance of it or the mechanism involved, but to offer some suggestions on "selection" by centrifugal force. In all mechanical concentrating machines the separation or selection is performed by gravity ; to some extent perhaps by adhesion due to the atomic structure of particles, and perhaps again to chemical affinity

when canvas is employed and "doctored," but on the whole concentration is selection by gravity.

Luther Wagoner, C. E., of San Francisco, some years ago conducted a careful series of experiments on the precipitation of particles through water, and from his observations prepared formulae, in which the element of surface was a principal factor. These experiments were the subject of a paper read before the Technical Society of the Pacific Coast, and form, so far as known, the whole literature of the subject as applied to settling processes. The main object was to throw some light upon the laws that govern the concentration of mineral particles, with what result cannot be stated, but there is this general fact pertaining to the whole matter, that gravity alone has been the active or settling force depended upon, and the gravity of particles becomes weaker as the particles are reduced and as their surface increases in respect to volume. This we know is true of water suspension, granite or quartz with specific gravity of 2.75 is carried as pulp or "slickens" for hundreds of miles in suspension, and fine dust of any material floats in the air when subdivision is carried far enough.

The suggestion is that if instead of gravity we apply the greater and controllable element of centrifugal force, can not selection or concentration be carried on more rapidly and completely?

This may be the idea or scheme that lies at the bottom of the present invention, and if so it is worthy of careful consideration.

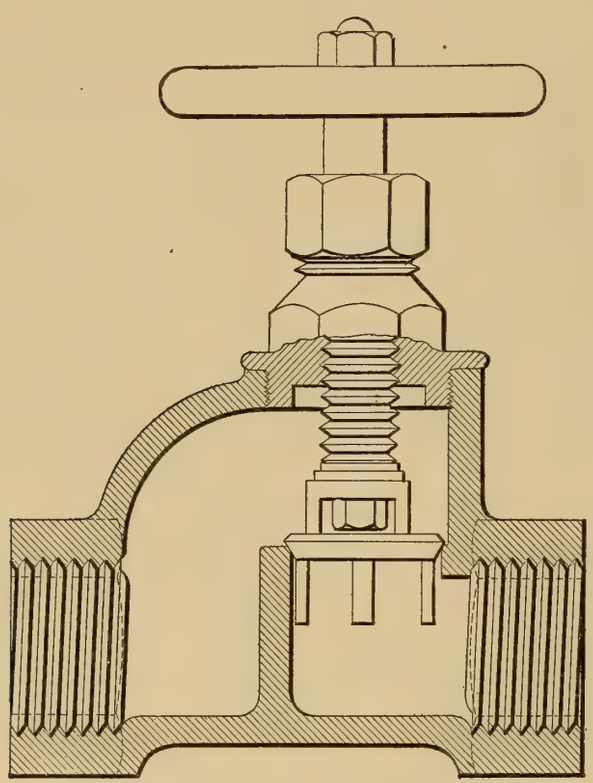
The drawings are too extensive and complicated for reproduction here and as at first intimated the specification is so drawn that the nature and objects of the invention are left to inference. Any one interested can study the patent and draw their own conclusions.

A New Stop Valve.

The section on page 182 shows a form of stop valve that may be less symmetrical than what we call a "globe valve," but is infinitely better in respect to functions. The commercial globe valve of our day is a contrivance that should be modified or disappear. The ducts are so obstructed and contracted that if a valve is put on a pipe where the flow can be observed, its obstruction will be a matter of astonishment. Some firms we know of have discarded the common form and provide an elongated body that affords a less obstructed flow, but the modification shown is better still, and more symmetrical

than the spheroidal form. There are, of course, the same angles for flow, and the design could be much improved by filling in the corners, but they are free or "full way" as the makers call it, and the shell requires no more material than the spherical, or globe pattern, with a diaphragm in its axis. The valves shown are made by a Nottingham firm in England, and the sooner it is adopted elsewhere the better.

Stop cocks, as commonly made, are another example of bad practice. Twenty per cent. more metal would permit apertures for a flow equal to that of a corresponding pipe, but to save this moiety the cocks are spoiled, and if a "free flow" is wanted the only way is to use a cock one size larger than the rated one, and bush it at the ends to receive a smaller pipe.



A NEW STOP VALVE.

These things are mysteries of modern manufacture, not in the making so much as in the buying. No one thinks of demanding or even inquiring what the capacity of cocks and valves are, but in some other things they will contend for one or two per cent. of efficiency. For example they will purchase a steam engine and require a guaranty of steam consumption, then will purchase a direct-acting steam pump incapable of performing with one half the same efficiency and be contented, or will purchase a centrifugal

pump stipulating that it shall perform a specific duty with a given amount of power, but will purchase a reciprocating pump, without question, that has half the efficiency of the centrifugal one. This is mainly a result of habit, if not, is inexplainable.

Screw Propellers.

VARIOUS RECENT PATENTS.

Among the patents selected for notice in this section were some on screw propellers, but after a careful consideration of them they are laid aside, and instead will be given some unscientific remarks that may earn, or deserve, criticism if not refutation.

In a late patent there is proposed a form of vanes for propellers having a curved edge at the rear, as the inventor says, "to discharge the water in a direction opposite to the vessel's course." The following is quoted from the specification of the patent referred to :

"The rear edge is curved around, so as to be nearly tangent to the ship's course, so the water will leave the blade of the wheel parallel to the ship's course, which is a desideratum, while with the old style blade the water leaves the wheel at an angle of about thirty degrees, and with an ordinary blade a large percentage of the force is expended in throwing the water out centrifugally, and a large part of the water passes over the ends of the blades, doing no useful work."

Mr. James Emerson, in his book on "Testing Water Wheels," speaks of fastening a ship to the dock and then driving the propeller to determine its thrust, and suggests a screw could be placed in a frame supporting a propeller, and the pull be measured by a brake or dynamometer. We might add other examples to show that the popular idea of a propeller is that it pushes the water away in a direction normal to the faces of the vanes, and the reaction from this diagonal thrust is the propelling power.

The lacking element, function, or condition in thus reasoning about screw propellers is the forward progression into undisturbed water, and this element in propeller action is not only lacking in popular opinions on the subject, but also in most mathematical treatment of the matter.

The inertia and immobility of the water through which a screw passes at various velocities of progression, is shown by the resistance to a flat surface when pushed through the water. Such resistance

being approximately as the cube of the velocity. One square foot at ten feet per second, requiring a force of more than 100 pounds to propel it.

A vessel moving at 15 to 20 knots an hour, or 25 to 33 feet per second, would meet with a resistance of 600 to 1100 pounds per square foot, on any surface normal to the course. The same law applies to the blades of a propeller, so that at high speeds of progression a screw may be regarded as working in a nearly solid "nut," and without much radial, centrifugal or other disturbance of the water. We use the term "nut" because it completely, if not accurately conveys an idea of the operation of a screw at high progressive speed, and it is only by this theory of the water's inertia that the efficiency of screw propellers can be accounted for.

With apologies to Professor Fitzgerald for this unscientific explanation, we think it contains the essence, so to speak, of propeller action, and disposes of the proposition of curved vanes to discharge water in any direction. In the investigation of the flight of birds there are some propositions respecting the forward movement into undisturbed air. The references are not at hand, but it is immaterial. Our contention is that the evolution of screw propellers as a history goes to show that the precise manner of their action is not known, and that the various forms proposed and made are based on theories that do not prove themselves in the results attained ; also that the diversity of practice in designing propellers is a warrant for even empirical opinions, here or elsewhere.

We are not speaking of or doubting the truth of computation in respect to form, friction, or operation of screws, farther than to claim that the progress into undisturbed or solid water is the main fact of all, that this is the principal phenomenon of propeller action, and that at thirty to thirty-five feet a second, speeds now attained, a propeller becomes a veritable screw in a "nut" nearly immovable, and that centrifugal effect, angular velocities, and so on disappear, leaving little but skin friction to be dealt with in the case of all the diverse designs that have a true helical contour. From some authorities at hand we cull the following :

"The reaction of a stream of water acted upon by any propelling instrument is the product of these factors, namely : The mass of a cubic foot of water, the number of cubic feet acted upon in a second, the velocity in feet per second impressed on the water by the propeller."—(*Rankine.*)

From a formula based on the above assumption it shows that

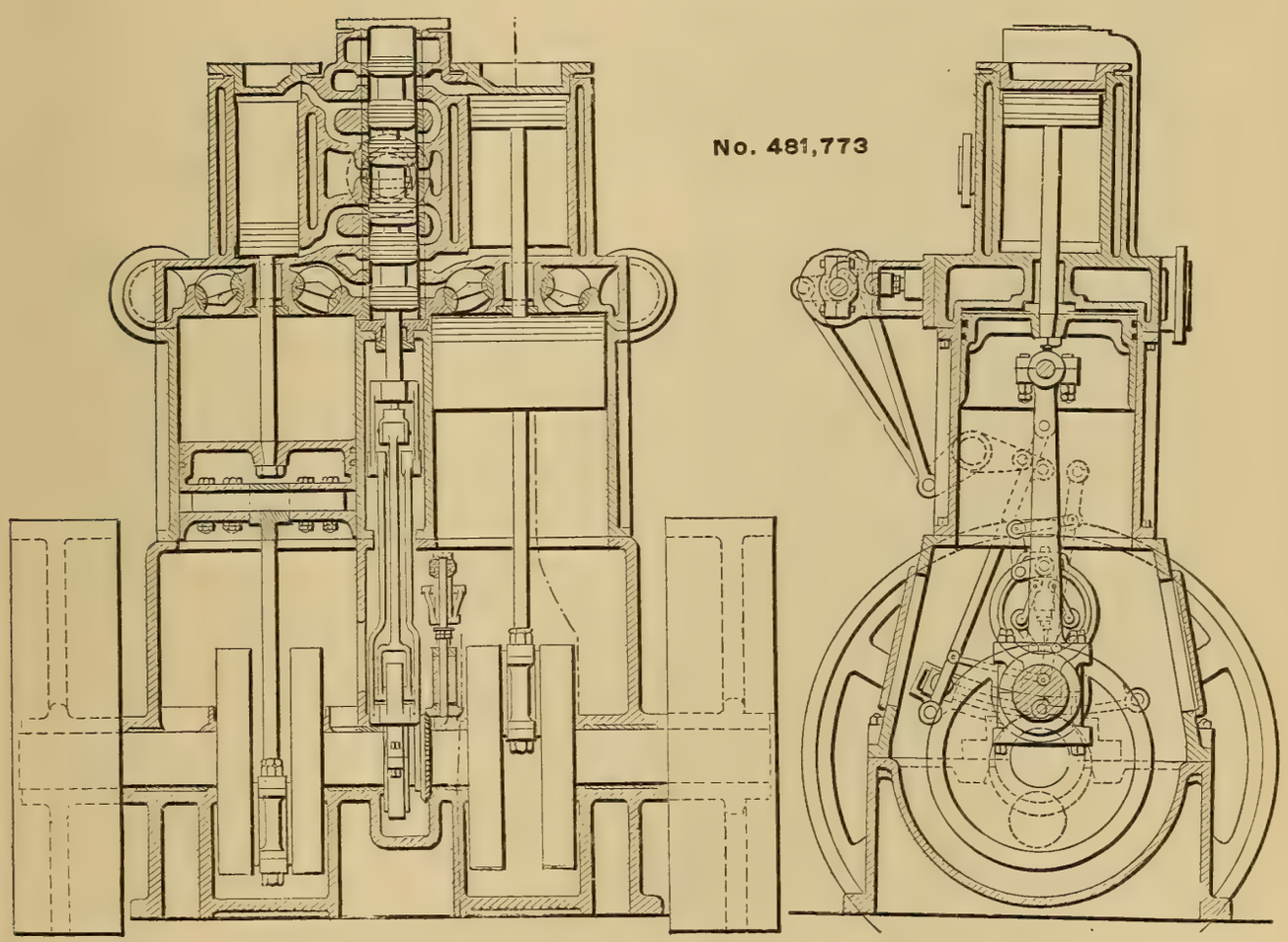
"the thrust varies as the velocity, and the lost work varies as the square of the velocity." Another authority says:

"To assert that a screw works with unusually little slip is to prove that it works with a large waste of power."

We might go on to quote a great number of propositions of the kind, including Mr. Froude's in his somewhat sweeping doubt of all various assumed formulæ relating to propeller action.

Patent No. 481,773, August 30, 1892.

Geo. S. Strong.—Compound Steam Engine.



This invention comprehends extensive features in design and arrangement that are very fully set forth by drawings and much less fully by the specification.

The invention relates to triple compound engines of the stationary type. The initial and intermediate cylinders are superimposed, as seen in the drawing, and two single acting low pressure cylinders beneath, the latter performing the function of guides

to sustain the diagonal thrust of the connecting rods and also constitute a section of the main framing.

Steam distribution for the first two cylinders is performed by a piston valve between them, and for the two low pressure cylinders by the gridiron slides shown in section at the top. The valve gearing is unique, consisting of what may be called a "floating link" and sliding block, controlled by a centrifugal governor, producing regulation by variable cut off in the usual manner. The slide valves of the low pressure cylinders have seats inserted in bored chambers, and are operated from a fixed point on the link, the whole valve system deriving movement from a single eccentric, as will be seen in the diagrams.

The external appearance of the engine is especially symmetrical, as have been various designs of Mr. Strong's, and the whole seems to have been the result of an effort to put into condensed and simple form various characteristic features of modern high-speed engines, in harmonious relation.

Without attempting an analysis of the valve movements, which at this day can be assumed as correct, when coming from the hands of a competent steam engineer, the present engine has the following features of note. The double low pressure cylinders and direct connection from the cranks to the pistons; reducing the height, or length, of the engine to that of a side by side or single cylinder one; the enclosure of all running parts, including the governor links and first movers of the valve gearing. All valve motions derived from a single eccentric. A built up frame consisting of a sub-base, crank chamber, low pressure cylinders, then the initial and intermediate cylinders, the whole tapering upward in the order of their respective cubic dimensions.

To trace back the evolution of steam engine arrangement and framing, taking the Westinghouse and Willan engines of 1880, and succeeding types of the single-acting type, down to the present time; the steeple-framed, direct connected marine engines of 1870 and since, with the many intermediate designs of stationary engines, verging more or less toward the two types named, one can see a kind of order and sequence toward an ideal vertical steam engine that is on its way, but doubtless far from perfected at this time.

The multiple cylinder arrangement, and the high pressures concommitant with increased expansion, have disturbed a good deal the gradual evolution of design. High speed has at the same time been added, increasing bearing surfaces, altering the means of

lubrication, and the material for bearings. It has been a struggle toward the ideal, with formidable obstacles arising at every turn, such as could not be turned aside, but must be absorbed or eradicated.

This race and struggle toward the ideal engine could never have gone on as it has without the powerful incentive of steam economy, or money saving, it may be called, constantly increasing in importance by wider use. The gain in this respect has outstripped even the endless modification in constructive features, or has paid the cost of experiments as we went along. Fairly stated, and with respect to steam power as a whole, the economy of fuel has been going on at the rate of one pound of coal per horse power for every five years of effort, and has now nearly reached the limitations set up by thermal laws, qualified by the possibilities of construction and maintenance, such as present knowledge permits.

Common reasoning in these things measures the future by the past, skilled reasoning does not, and to claim that the future is to see changes in the design and operation of steam engines go on as in the past is not a rational assumption, nor is it in accordance with familiar precedents. For example, the Jonval and Fourneyron turbine water wheels were introduced in this country about thirty and forty years ago respectively, and among the very first wheels set at work, those at Lowell and Philadelphia for example, are as good wheels as can be made now, not only in respect to efficiency, but in construction as well.

It is true the element dealt with was tangible, ponderable and amenable to physical laws tolerably well understood for a century past; not like heat surrounded by mystery, intangible, invisible, and with newly discovered relations, but making allowance for all this, there is no doubt that steam engines are fast approaching a state at the present day that may be compared with that of water wheels in 1850 and 1860, and the present engine, whether many or a few of its characteristics survive in future practice, seems another step toward the ideal.

The internal-combustion class of engines, which, according to many conjectures, are to supplant the steam engine, have now some advantage in fuel consumption, or fuel cost. Gas or petroleum burned within a cylinder is apparently a cheaper source of power, because the method is novel, and the value of heat-producing fuel has not had time to adjust its price on the basis of its "energy," as a motive element. Even power itself is far from having a settled

commercial value such as we may reasonably expect it to have in the near future, and of course the elements of its production must vary more still, but when the value of carbonaceous substances is determined by their heat, then the internal combustion engine, as now made, will be at some disadvantage with its high temperature, sudden impulse, and consequent irregular strains.

BRIGGS IN SCANDINAVIA.*

No. II.

I knew that Briggs would in one day learn more of Danish affairs than I could in a week, and not to profit by his observations would have been to come away uninformed. I therefore continued the conversation with a remark about the country.

"Denmark," said Briggs, "is but the threshold of the Scandinavian countries. You see in Copenhagen but the door. I am going to Sweden."

I had myself taken passage for the next day to Gothenburg, and was astonished and pleased to find that Briggs had done the same. "This country," said Briggs, "was brought more in contact with Latin and Celtic civilization than the more Northern States. The people have here a proud history of daring and successful conquest that in modern times we call robbery. Robbery! If an old Dane with fifty men landed on the Latin coast or elsewhere, and drove out the population of a city and took away the spoils, that was robbery! If Napoleon razed a whole country with a soldiery numerically equal to the male population, that was conquest — victory! Bah! This is the modern view of the case. Who crossed the Atlantic in frail and illprovided ships long before Columbus or Ferdinand of Spain were born? The Northmen! And what is said of it now? I may say, who even knows it now? Read the Sagas of Iceland."

"Excuse me," said I, at that moment I had picked up a "Dansk" newspaper, and Briggs' proposition reaching my ears at the same time that the Danish print met my eyes. Briggs looked hard at me for a moment and went on smoking for a time in silence, and then asked, "Have you secured your photographs?"

*The present articles, here altered and revised, were written by the Editor of INDUSTRY, for a foreign publication, in 1885, and have not been published in this country. "Briggs," it need hardly be said, is the "Uncle Camshaft" of "Techno."

"Don't you know," said he, "that everyone who comes here, to Copenhagen, carries away a portmanteau full of photographs, taken from Thorwaldsen's statuary? You are now in the city that has the honor of giving to the world a genius, who among sculptors has no peer,—who in his art was greater than Shakespeare in the drama, or Homer in poesy;—that man whose genius is equalled only by the enormous extent of his works!"

I hinted that Thorwaldsen was a modern sculptor. This touched my friend on a tender point. "Truth is truth, wherever found," said he; "but the strength of arguments based upon facts is measured by parallels." Seeing the long argument that this new proposition foretold, I instantly ordered luncheon.

The next morning found us on board the steamer, and I ventured to ask Briggs what had called him so far North in the winter.

"I came," said he, "in the interest of an argument. I am going to Stockholm to examine records, and if necessary shall go also to Norway, or even to Iceland, to attain the object I have in view. A society of which I am a member, has one and all thought proper to extol the amount of liberty enjoyed in modern times, and my business is to prove them mistaken—utterly mistaken. Already have I hurled the Grecian, Roman and Italian Republics in their teeth, and now intend to complete the argument and leave no vestige of this assumption remaining, by showing the development —or rather the existence—of civil liberty in Sweden nine hundred years ago!

We steamed slowly out of the harbor, passed the "school ships," which in number and size seem out of proportion to so small a country as Denmark; passed the famous old citadel, that for ages was considered impregnable, and finally out into the sound—the "K-a-t-t-e-g-a-t!" said Briggs, spelling the word carefully.

Two hours later we were off the ramparts of Elsinor, or "Helsingor" where the ghost of Hamlet's father walked abroad, and thereby, together with its declamation, provoked an imitation and emulation that has descended even to our times, not alone in the channels of poesy nor upon the legitimate stage, for years ago I heard this ancient ghost declaiming in a country barn.

I looked around and espied Briggs looking over the rail, straight down into the water. Directly he made a motion, as though he was going to jump over head foremost into the sea, and I ran to him as quickly as I could. He turned towards me with a ghostly face. "Punch," said he feebly, and started for the cabin. In ten

minutes more I followed. Tell about crossing the Channel! Talk about the Bay of Biscay and the North Atlantic! For genuine "cockscrew" convolutions of a ship, commend me to the Kattegat in a stiff wind and a short ship. My romance and Briggs' philosophy having been effectually snuffed out, we remained below until evening, when we reached the "Göta Elf," or Gotha River, on the banks of which stand Gothenburg.

For half a dozen miles below the city the river is filled with granite rocks — small islands scattered right and left — suggesting that they might have at some time been rained down in the greatest confusion. The channel is so tortuous and the danger so great in running through these granite islands, that the captain concluded to wait until morning before proceeding up to the city, and a rare opportunity it gave us in the morning of seeing what no other port in the world can claim; for miles, indeed, until the spires of Göteburg were in view, not a square yard of earth is seen; all granite, hard, cold, grey granite.

One becomes sceptical, as they proceed up the river, as to whether any human being can exist in such a place; not a tree, a shrub, or a blade of grass! The fishermen's huts, the only habitations of any kind to be seen, are lashed to the granite rocks with iron rods, to keep them from being blown away.

I arose in time to see this wonderful picture of Nature's hardest face, and was so intent upon my own reflections that I forgot Briggs for a time. I knew well enough that he was "abroad." He was on the bridge with the Swedish captain, the latter engaged in the double duty of pointing out noteworthy objects and avoiding Briggs' umbrella, which he always employs in conjunction with his tongue in explaining his thoughts, especially when forcible demonstrations are called for. He was talking English; his knowledge of "Svensk" was not sufficient for the expression of his feelings under the circumstances. "Come up here," said he, "and get a good view. Here are associations that should stir the mind of any one. Here, sir, among these granite rocks in this cold, bleak land, was bred a race of men whose arms carried terror to the hearts of a more numerous people skilled in the so-called arts of a superior civilization. Here, from these barren plains of Gothland, went forth the white-haired barbarians who conquered Rome."

"Gothland," said he, "is the name of a Baltic Island; but this country, the south of Sweden, is level, although the best or most fertile part of the country is poor enough. Why, sir, this

peninsula of Gothland has more history in it than half the rest of Europe. Gustavus Vasa, Gustavus Adolphus, and Charles XII. drew from here the greater part of armies who never counted their enemies. Military science, except as modified by improvements in weapons, rests now more upon the tactics of Gustavus Adolphus than those of any other great captain."

Briggs was going directly on to Stockholm, and so intent was he upon the main objects of his journey, that no persuasion would cause him to stop in Gothenburg.

This beautiful little city is situated at the mouth, or nearly so, of the Gotha River, which drains Lake Wenner. This river, because of the cataracts, is not navigable for any distance above its confluence with the Kattegat. The celebrated Gotha Canal, which was 400 years in building, forms part of the waterway between Gothenburg and Lake Wenner.

This is the commercial entrepot of Sweden. Having a safe harbor, and lying on the side of the country towards England, the growth and future prosperity of the city must be measured by the development of Sweden. It contains 80,000 inhabitants, but measured by other standards than the population, the city may be considered as representing a population twice as great. In the central part, not an inferior building is seen. The streets are paved perfectly, the curbs and gutters being cut from single blocks of granite 20 inches or more in width. Canals of clear fresh water pass through the principal streets. The old ramparts, now demolished, have, as in most old European cities, furnished a site for wide boulevards that surround the outskirts.

There is a naval school, a polytechnic school, a small, though fine, museum and theatre that is a matter of astonishment to strangers. There are also several fine churches, the spires of which are covered with copper. The statue of Gustavus Adolphus, in the public square, is a noble work.

Two days later I went on to Stockholm, a long ride of two hundred and forty miles, across a country, with few exceptions, barren and bleak. I reached Stockholm, and taking a cab to the Hotel Rydeberg, inquired for Briggs. "The man with an umbrella and red whiskers?" said the porter.

I found Briggs in his room at a large table covered with books, papers, and manuscript. At one end sat a Swedish interpreter, at the other a courier; my friend in the center with his coat off, and so intent upon his work that he did not even look up when I entered.

"Come in!" he answered to the knock; and after entering, as said, it was some time before he looked up and stared a moment to collect his thoughts. "O yes! glad to see you. Take a chair," he said; and in a moment, without any questions as to how and when I came to Stockholm, he went on. "I have found all and more than I expected. What is the reason that some of this vast store of literature here in the North has not been translated into our language? Why is it that I must travel a thousand miles to Stockholm and employ an interpreter to get at facts in history, which, if they had transpired in the Latin Peninsula, would have had almost as many chronicles as there were actors? It is an infernal shame," said Briggs, rising to his feet and overturning his chair. "Is Jupiter so much greater than Thor? Is the mythology of the North devoid of interest to us, the children of the Scandian race? What, I say, does this mean? Why, sir, even Holywell Street contains not a volume in which we can read of this country; so rich, not only in history that should have the foremost place in our memories, but rich also in a literature, to us a sealed book.

"Look at Geiger!" said Briggs, bringing his hand down upon a book that lay on the table with such foree that the ink was upset, and the two assistants moved farther off and looked amazed. "Look at Geiger! In no tongue on earth has more eloquence, beauty, and descriptive power been written. What country has a greater historian? His history of the Swedes has been in part translated into English, and why not completed? Why is not the book in all of our libraries? And why are we not as familiar with the history of the Swedes as we are with the history of the Latin races? I will tell you," said Briggs, his tone becoming slightly sarcastic. "Our affinity is and has been for centuries with the Latin and Celtic races. We find it flattering to compare our progressive modern civilization with that of Rome and the Latin people. It is not pleasant to admit the daring and conquests of these Northern people that two centuries ago buffeted us about as our troops now do the Abyssinians. Besides, the progress here is such as to disparage even our own boasted achievements. Sweden, with a little more than four millions of population, has six thousand free schools! Six thousand free schools, sir!" Again Briggs' hand came down upon the table, causing "Geiger" and other volumes to bounce like puppets.

I ventured to inquire how he progressed in the main object of his research.

Briggs reached for a book, and from between the leaves drew forth a manuscript translation, put on his glasses, and after scanning the paper for a time, went on as follows:—"When Olave, the Lap king, reigned in Sweden, he aspired to the Government of the Norse country also. This proposed dual government had no object beyond the king's ambition, and was distasteful to the Swedish people. Norway had no power to resist the Swedish king, but sent envoys from among her nobility and chief men to make a verbal protest against this scheme of Olave's, and were instructed to deliver their message before the Swedish king in person. These Norse nobles were afraid to go before the Lap king, and first went to Thorgny, the leader of the peasants, one of the chief 'laymen,' and asked his intercession in favor of the Norse petition. When the matter was presented to Thorgny he listened in silence to what was said, and then made the following reply to the petitioners:—

"Strangely you comport yourselves, ye who bear the noble name. Why didst not bethink thyselves, before setting out upon this journey, that thou wert not strong enough to speak to our King, Olave. To me it seems not less honorable to belong to the peasants and have liberty of speech even before the King."

"How does that sound?" said Briggs. "These words are now eight hundred years old. But this," continued he, "is not all."

"A Folkmeet was called at Upsala, and the King with the people assembled. The Norse ambassadors presented their protest; but the King was offended, and stopped them in their harangue. Swedish nobles also spoke; but with the same result. Finally, Thorgny, the leader of the peasants, arose and all was silent: He said, 'we the peasants will that thou, King Olave,' do thus and so, 'or we will turn upon thee and slay thee; for so our forefathers did, who threw five kings into a well, who, like thee, were puffed up with pride!"

Briggs' reading of Thorgny's speech was well worth a trip to Stockholm. After finishing, Briggs stopped a moment, and then said—"Talk of Demosthenes or Cicero! When have you heard a speech like that? Think of the circumstances. The leader of the peasants standing before the strongest king that Sweden had ever known, and speaking like this. Is not this civil liberty? What is the use of parading the stubbornness of the Dutchmen against a foreign ruler as an example of civil liberty, when here, on this ground, six hundred years before, was a Republic more complete, and one that has lasted ever since," added Briggs, sitting down quite exhausted.



LAUNCH "TILLIE," TWO HORSE POWER.—UNION GAS ENGINE CO., SAN FRANCISCO.

POWER LAUNCHES ON SAN FRANCISCO BAY.

The Union Gas Engine Co., of this City, have just issued a new edition of their "marine catalogue," and send us the plate opposite, which is not included in the published illustrations. A description of the plate would be superfluous, except to say that the boat is the *Tillie*, of two horse power, the scene at Kelso, Washington, and the man with the pipe, a philosopher.

By an enactment of Congress, conceived in stupidity, or else made to protect pilots and engineers, "vessels impelled wholly or in part by steam," are not allowed to navigate the waters of this country without being in charge of a licensed engineer and pilot.

Aside from the unreasonableness of such a statute, and the amount of lying and deceit it has called out in efforts to evade the law, it has been productive of one good result. It has lead to the invention of boats not "impelled wholly or in part by steam," still having the required motive power and with advantages over steam. This, we say, is a good result, but it does not destroy, but increases, the absurdity of the regulation named, and yet in force, respecting steam-propelled vessels. In the Bay of San Francisco, with 500 miles of coast, and from 5 to 10 miles wide, the protection of human life demands two licensed officers on a launch even of the smallest size, but in the Thames, at London, 500 yards wide, with five millions of people crowded within a distance of ten miles along the banks, and the surface swarming with all kinds of craft, no such paternal requirement exists.

As remarked, the evasion of this law has been a powerful incentive in developing the "internal combustion" engines for boat driving, and if we keep on in the ratio of three years past, a gas engine launch will be included in the equipment of all families having the required male representatives.

At Sausalito the launch fleet is becoming an armada, and each new boat has some added feature or improvement that calls out emulation. The builders are harassed with inquiries and orders, so much so that they cannot find time to fit out larger vessels, which is an ambition among them now. The engines are reaching fifty horse power, and will, no doubt, reach a hundred soon.

An opinion as to the merits of gas-driven launches is not called for, the facts we have reverted are of more importance, and the only

field for conjecture now is, as to how many such launches will be in use if things continue as they are going now.

We can well remember when, three years ago, Mr. M. M. Barrett, of the Union Gas Engine Company, brought on the Sausalito ferry boat one day a tiny little launch, about twelve feet long, fitted with a small gas engine. People stared at it and laughed, but that little boat is in commission yet, after running many thousands of miles, and has never, that we know of, had any accident from faults of construction or want of endurance.

Secretary Barrett, of the San Francisco Gas Light Co., followed with the *Madrone*, a more pretentious boat twenty-two feet long, also in commission yet, and then they came in scores, until at the present time the whole fleet must number more than three hundred, counting gas engine driven craft of all kinds in this Bay, or built here for other waters.

The last novelty we have seen was a "stern wheeler" for service on Eel River, in Humboldt County, a strange looking craft that was taken away without her cabin mountings, on the deck of a ship, after successful trials here on the Bay.

Advices from the Eel River district say this stern wheel packet makes four miles an hour against a flood current, and has opened up an important traffic to points hitherto almost inaccessible, in a stream, one among a score on this Coast, that can be navigated in a similar manner.

There is no infraction of the navigation laws by these vessels. None of the mail or coast steamers have been run down, no wharves destroyed, and, so far as known, not a single life has been lost in navigating them. Compared to the casualities from sail boats in San Francisco Bay, it is these that require govermental regulation. As a guess, their danger is ten times as great as with power-driven launches, and a rational law in the interest of public safety would be to examine and license everyone who ventures out in a boat "impelled wholly or in part by sails."

CABLE PROPULSION.

Mr. Frank J. Sprague, president of the American Institute of Electrical Engineers, in his late address before that body, disposes of cable traction in the following words: "In many streets, of course the cable will hold its own until an electrical conduit or surface contact system shall have proven satisfactory."

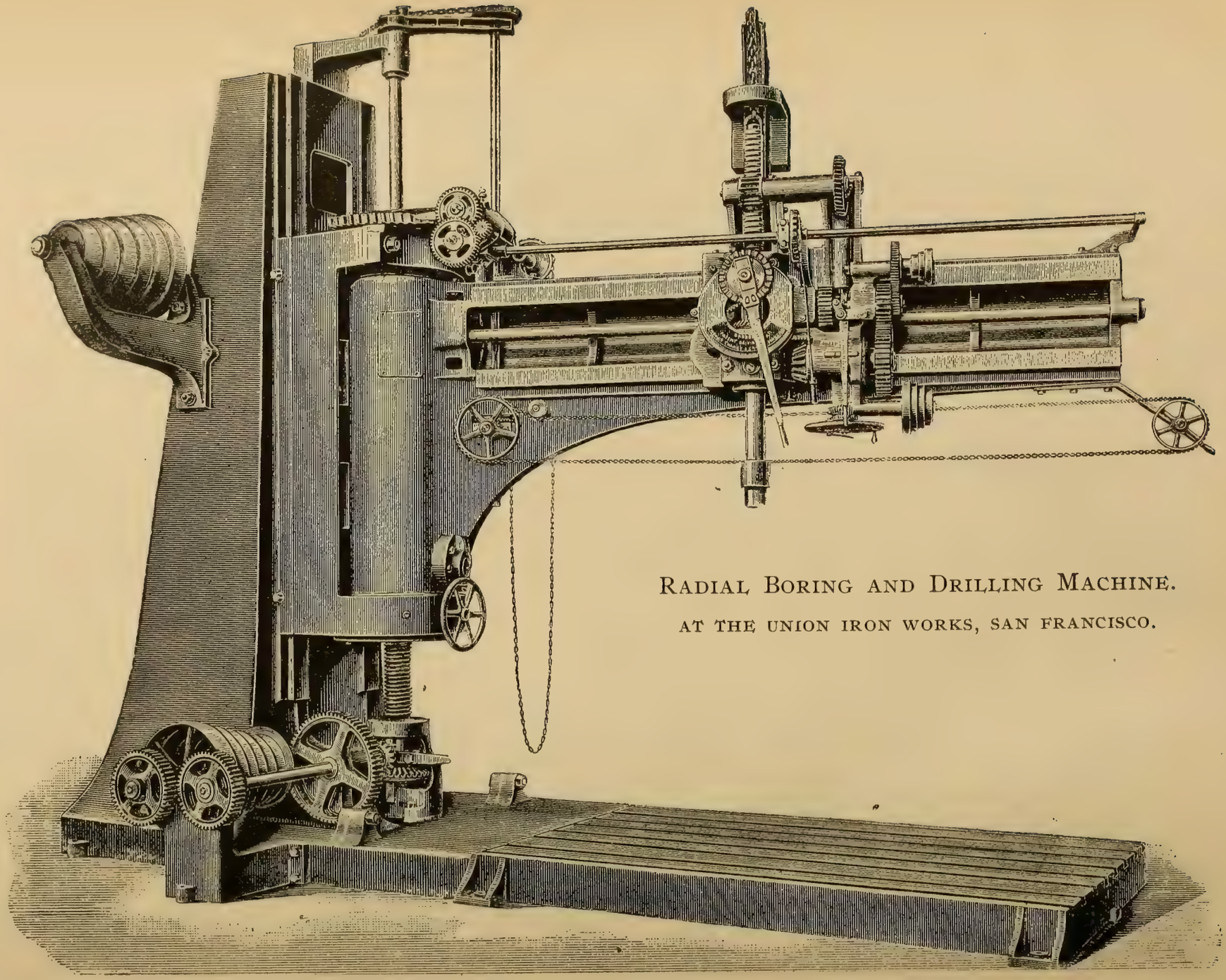
No one will dispute this proposition in respect to level grades, and Mr. Sprague, like most people in New York, does not see far beyond his own environment, but the fault is, that there was not given something more clear respecting the nature and relations of cable traction.

We will further contend that satisfactory electric conduits have but little to do in the case. The cable system is one that deals with grades, and until electrical methods can utilize the gravity of the "down traffic," the cable system will remain, as it has for centuries past, the most economical way of operating on steep grades.

In a city like San Francisco, for example, where the traffic has to be raised on grades of 20 per cent. and more, commercial working demands that the rising loads be balanced by the descending ones, and herein lies one limitation, but not the only one, because no kinds of self-propelled cars are capable of ascending such grades, and besides, must waste the gravity of the down traffic in friction.

The best way to promote electrical propulsion for street lines is to admit and consider this matter fairly, and not ignore it altogether, as in the present case. There are many cities where no other method than cables can be employed. Such cities as Quebec, Brussels, Sheffield, Birmingham, and dozens beside, where the principal lines of traffic must be on grades that render frictional traction out of the question.

Mr. Sprague's generalizations respecting the adaptation of electrical propulsion to common railways, shows a great deal of study and investigation, that has developed on the whole more impediments than promise. The fact is, as President Sprague candidly admits, the gap is too wide at this time between urban traffic on easy grades, and the general traffic of a modern railway, to permit useful effort. There is too much yet to be done in the earlier and easier applications of electric propulsion to spare effort in this wider field at the present time.



RADIAL BORING AND DRILLING MACHINE.

AT THE UNION IRON WORKS, SAN FRANCISCO.

RADIAL BORING AND DRILLING MACHINE.

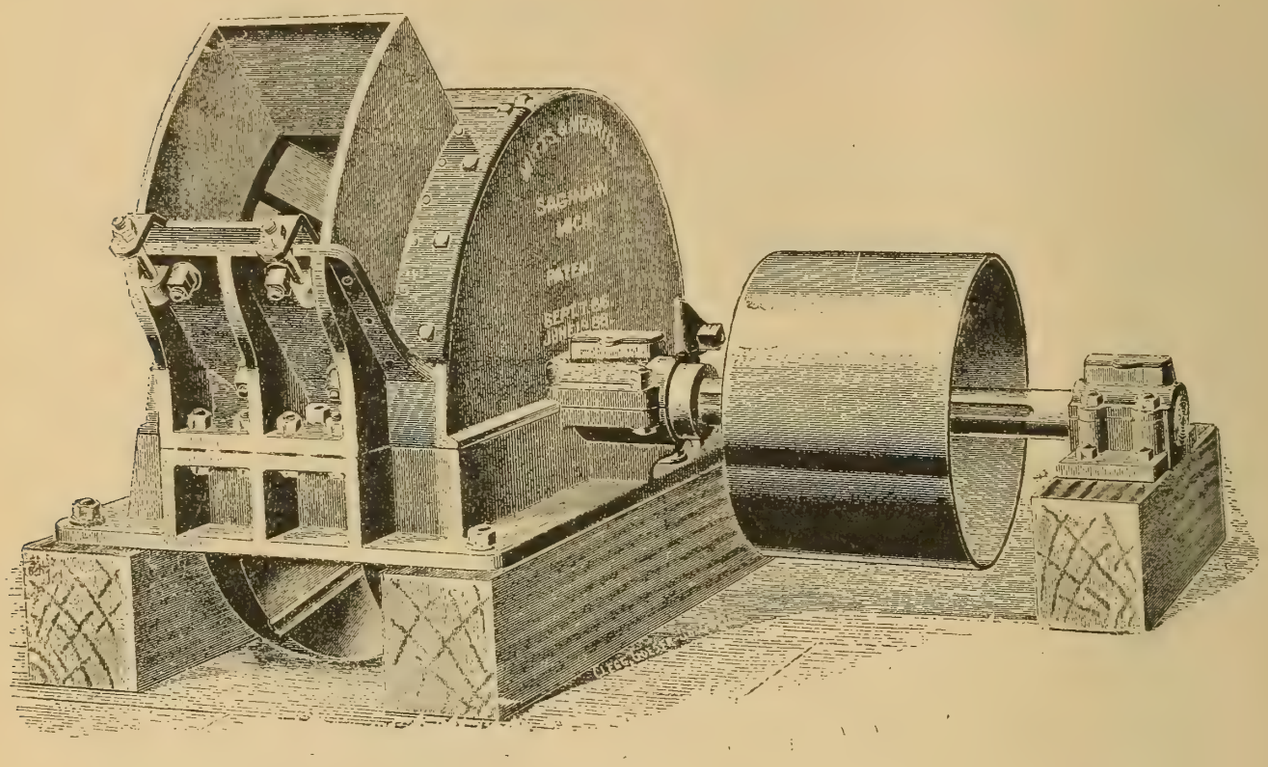
AT THE UNION IRON WORKS, SAN FRANCISCO.

Among the various machine tools that have achieved what we call a standard place, none are so weakly supported by inherent merit as radial drilling machines. As machines for drilling alone, it is hard to find the money's worth in their functions or capacity, but if they are capable of boring, as but few of them are, their value and place in a works then become more obvious.

The above machine is one designed for boring as well as drilling, and from inquiries made we find it will bore a "round hole" and has proved, in practice, a valuable implement. It is the largest machine of the kind on this Coast, perhaps the largest one in this country. It weighs nearly 60,000 pounds, or thirty tons. The spindle moves out 13 feet from the column, and work 11 feet 6 inches high will go under it. The machine was made for the Union Iron Works, by Messrs. Shanks, of Glasgow, Scotland, and has a great variety of adjustments, changes of feed and motions, not common in machines of the kind.

It is open to some criticisms in its design. The variable or back gearing, should for boring, be on the spindle instead of on a motion shaft twenty feet or more from the cutting tools. This introduces an element of elasticity that is objectionable. For drilling this does not much matter; all that is required is to revolve a spindle and maintain its position normal to a table or face of the work, and this is not much. Aside from torsion a drilling spindle two inches in diameter is as good as one six inches in diameter, so long as the tools are supported and guided by their points, but as soon as the work of cutting is supported by the rigidity of the spindle, as in boring, facing, and so on, then a spindle cannot be too stiff.

In the present machine a much larger spindle than the one shown would be better for boring, and just as good for drilling, but then again a larger spindle would be of little use unless the radial arm was equally rigid. In this respect there is provision exceeding any machine of the kind we have seen, and as before said it has performed its work well and is quite an important implement in marine work, on which it is most of the time employed.



WOOD CHOPPING MACHINE.

The above machine, which passes under the euphonious name of a "hog," is a new and very useful implement in saw mills, employed to chop up waste into such dimensions as will permit it to be handled in bulk and for fuel.

The name, which we will first refer to, is an unhappy illustration of the modern tendency to "machine slang." Imagine someone who does not know of this slang name, and that means nearly every one, looking into the dictionary for the definition of "hog." We have in use horses, dogs, mules, and now a "hog" in machine names. It shows a poverty of resources, and is childish, besides is wholly unnecessary. There is nearly always some relevant name at hand. and if not that, some title that can be peculiar to the thing named, but this aside, the machine above, which we call a chopping one, as the most relevant name thought of, is really an invention of much merit.

The machine consists of a cylinder armed with twelve knives, making up a weight of 3,500 pounds. The whole machine weighs 7,000 pounds. The power consumed is indicated by the large driving pulley, but as the work is intermittent it must not be inferred that this amount of power is required continually, or on the other hand

that a band as wide as shown would cut up even a small slab if not aided by the momentum of the cutting wheel.

The throat of the machine shown is 16 × 20 inches, and it is supposed to "chaw up" anything that will pass into this aperture. It is, as before remarked, a wasteful method of cutting up wood, in so far as power, but power is not much considered around saw mills, where the waste far exceeds what is required for fuel. Either saws or cutters will produce enough fuel to furnish the power to drive them, and this leaves slabs and other waste to be got rid of.

The machine shown is made at Saginaw, Michigan, by Messrs. Mitts and Merrill of that city.

MACHINE PAINTING.

It is the exception on this Coast to see machinery painted with what may be called opaque paint, containing no oil or varnish, consequently we have the name of making rough castings. It does not require much judgment and still less observation to know that any paint that shines or glistens will show every imperfection and pin hole in a casting, also will show in a conspicuous way, the smallest deviation in flat surfaces, while with "dead" paint, which is at the same time the best paint, the surfaces look smooth.

Another fault of shining paint is that it "kills" all the finished parts. There is little use in finishing any portion of a machine and then painting the frame some gaudy color and varnishing it. The effect is a burlesque on taste, and independent of painting cast iron any but a natural color, there is the fault that no paint of the "chromatic" kind will stand. It is soon destroyed by animal or mineral oils. If all the machinery made in San Francisco was painted with the steel colored paint employed in the East and almost everywhere else by the best makers, it would be classed higher, and could be sold at higher prices. Dead steel paint is a symbol of well-made machinery, while fancy colors indicate what is sometimes called "cheap and nasty."

In Philadelphia it is common to give all castings a coat of paint as soon as they are cleaned and before working. This prevents rusting, and by the time the castings are handled and finished they have a smooth surface and are ready for a final coat. There is also the advantage that anyone can apply the steel colored dull paint. It requires no skill, answers in all cases against corrosion, and, as before said, the action of animal oils.

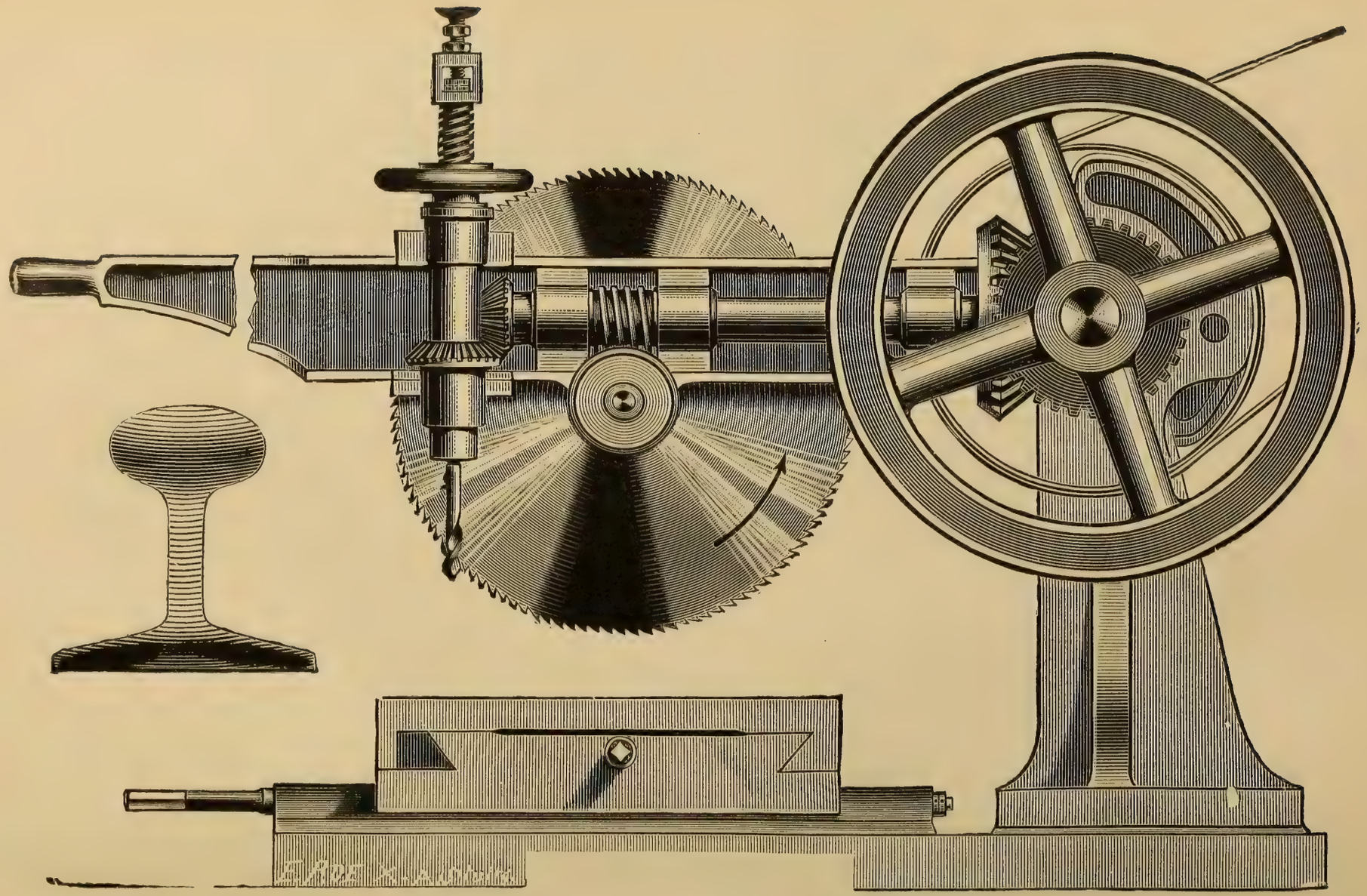


FIG. 1. COLD METAL SAWING MACHINE—GUSTAVE EHRHARDT & SONS, PITTSBURGH, PA.

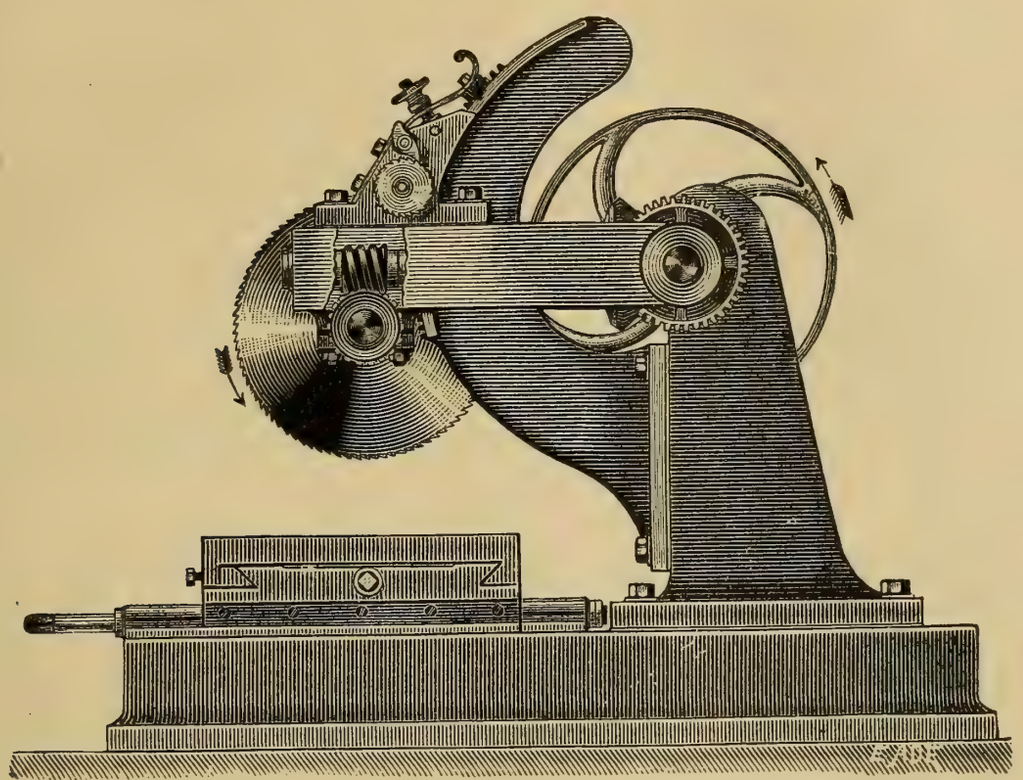


FIG. 2.

COLD METAL SAWING MACHINE.

GUSTAVE EHRHARDT & SONS, PITTSBURGH, PA.

The engraving above, and the one on the opposite page, illustrate two types of cold sawing machines, an important class of implements that we were singularly slow in adopting in this country.

Their use for cutting structural iron, ship iron, railway bars, and so on, became general in Europe at least ten years ago, and a good many machines now in use in this country have been imported from there. One recently by Messrs. Ehrhardt & Sons, larger than they were provided with patterns for, that cost $30,000.

The principle is simply that of a plain circular saw, having teeth and temper suited to metal instead of wood, but the feed, or method of presenting the material varies a good deal. Messrs. Ehrhardt seem to employ in most cases, especially for the smaller class of machines, gravity or elastic pressure, while in most of the European machines we have seen, the feed is positive. The former is no doubt best, or at least is more free from accident, provides for dull saws, and is more speedy because of permitting the saws to work up to their full capacity and to advance in proportion to the

section being cut. This latter is important in cutting off channel or railway bars and the like.

In the machine shown in Figure 1, the pressure on the saw is obtained by gravity and the strain of the bevel driving gearing at the pivotal shaft. In the other machine, Figure 2, the downward or feed pressure on the saw is obtained by a friction brake or traction gearing, that produces an elastic and adjustable strain for feeding. In both cases the work is laid on a plain table and is much more conveniently placed and held than in the case of machines feeding horizontally.

Messrs. Ehrhardt & Sons have made a large number of these machines, and a proof of their utility is found in the fact that wherever applied, they perform their duty in a satisfactory manner.

Metal band saws, to which this firm seem to give some attention, are also much more common in England than here. In Sir William Armstrong's works at New Castle, England, there were six years ago, fifteen such saws in use, and no doubt a number have been added since. In slotting out cranks, for one thing, a band saw is an important implement in a machine shop.

In one case, we know of an order given for one by an engineering firm, who, when written to find out the nature of the intended work, said they really did not know, "they were purchasing the machine on general principles; others used such machines, and we must find out what they will perform by experiment in the works." This firm we need hardly say was one of the progressive kind, and has progressed accordingly.

ENGINEERS AND ARCHITECTS.

[Communicated.]

To the Editor of Industry:

Sir:—I was quite interested in the communication of "Thermo" in Industry for January, as it is so much like the conditions in this and some other cities, where the architect assumes to know all about the engineering requirements as well as his own portion of the design, and frequently with results that are anything but encouraging to those who pay for the work.

Whether it is from an innate dislike of acknowledging that there is anything that they do not know, or whether it is that their percentage would be lessened by the amount that would have to be paid for the services of an engineer, I do not know, but the fact is, that

architects' engineering is not a success, although I am free to admit that engineers' architecture might not be a success as a thing of beauty, and engineers generally seem to know enough not to attempt what is radically out of their line.

In one case, in a large hotel building, it was discovered, after the walls were all up, that there was not sufficient height for the boilers, they were accordingly sunk about two feet, and a small recess sunk in the floor in front of each so as to admit of firing in some shape. The firemen climb down in one hole to fire one boiler, and then climb out and into a second hole to fire the other boiler; besides this they have to wheel their coal about seventy-five feet through a narrow passage with two or three turns, all of which of course helps to develop their muscles and break up the otherwise monotonous occupation of firing.

In contrast with this is a plant near by, designed by an engineer who had some respect for the men who handle the shovel. In attending this plant of four 75 horse power boilers the firemen have less work to perform than the other one with two 60 horse power boilers, and with no more cost of building construction.

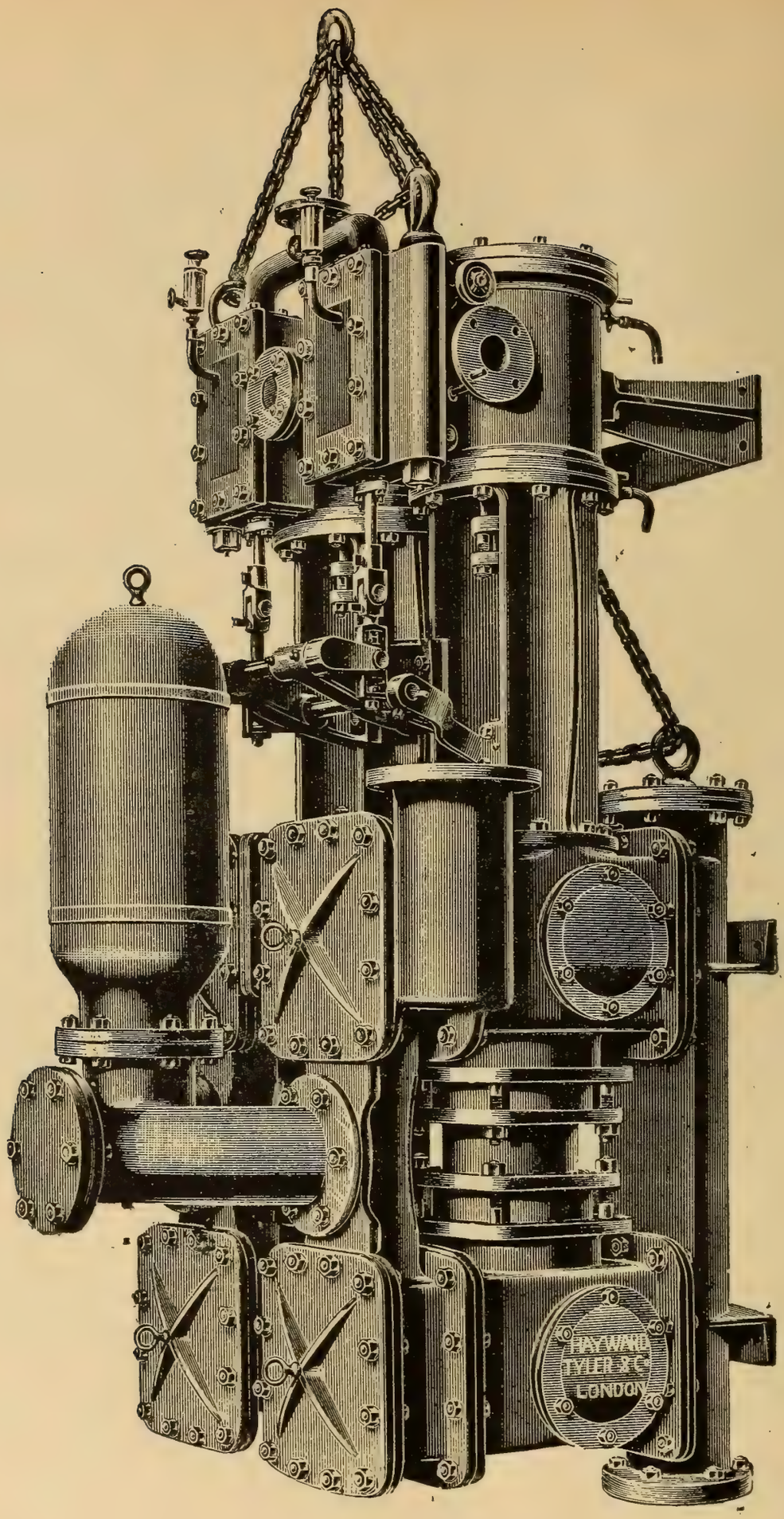
On another occasion an architect who was looking after the boiler arrangement beneath a building, was remonstrated with by an engineer for making the arrangements unnecessarily awkward, he said that he was not expected to study their convenience, he would get the plant in, and they would have to do the best they could with it afterwards.

In another case of an expensive and massive building, with plenty of room around it, the boilers were placed about 300 feet away in an elegant looking boiler house, and it was expected that the engines for driving dynamos would have been placed near the boilers, but not so, they were erected in an addition to the main building, disfiguring the design, and regardless of the fact that the electric current could have been conveyed 300 feet for much less cost and loss than the steam, and also of the fact that the engineer in charge would be far better able to keep everything in order with all his machinery reasonably close together.

I suppose architects are somewhat like other men, and like to get all they can, and that the only chance of improvement in the direction referred to is in approaching the owners, and, as far as circumstances will permit, explaining to them the absolute necessity of doing as is done in ship equipment, and having each part of the design and construction under the supervision and control of men of experience in each different department.

WM. J. SILVER, M. E.

Salt Lake City, Utah, Jan. 10, 1893.



AN ENGLISH DUPLEX SINKING PUMP.

HAYWARD, TYLER & CO., LONDON.

AN ENGLISH DUPLEX SINKING PUMP.

HAYWARD, TYLER & CO., LONDON.

The design opposite we reproduce from a drawing in *Industries*, London, of a duplex sinking pump made by Messrs. Hayward, Tyler & Co., London.

This firm, about 1865, took up the manufacture of the "California pump," a kind of hand-lever modification, often seen in California now. Later on the firm began making various modifications of pumps produced by the Cope and Maxwell Company at Cincinnati, Ohio, also the Rider cut-off engine, and other kinds of successful machines made in this country.

They have a works in the heart of old London, almost the only one left there, and have been in business under the same name and in the same place for more than a century. They have also at Luton, on the Great Western Railway, out of London, a large works where the pump shown opposite was made.

The pump is arranged for operating in either a vertical or horizontal position, and to raise 50,000 gallons an hour 100 feet high, with a steam pressure of 60 pounds per inch. The steam cylinders are 14 inches, and the water cylinders 12 inches diameter. The design will be a matter of interest here where so many pumps of this kind have been made and used in mining operations.

FREE MATERIALS.

Over one hundred owners of the principal iron and machine works in this City have signed a petition to Congress praying for the removal of custom taxes on iron ore, coal, coke, scrap, pig and other iron, and have, in so doing, exercised a rational judgment.

This Coast has suffered in a peculiar and excessive manner from inflated prices of material caused by custom duties. There are no compensating means augmenting the prices of finished work. Most of this material, or, as we may say, nearly all of it, has to be imported here from distant sources, and worked up in competition with the more extensive and organized manufactures in the Eastern States. Freight is paid not only on the utilized material but on the waste, and at rates in many cases higher than were charged for

transporting similar finished products from the East to this Coast.

The sacrifices made have been extensive and cumulative. Self preservation has become not only a duty but a necessity, and there is much encouragement in an unanimity of opinion such as the petition referred to indicates.

This Journal, since it was founded in 1888, has constantly urged in such terms as its nature permitted, the necessity of reducing the cost of the elements that enter into our skilled manufactures. We have high wages from causes that need not be entered into here ; we have high expenses from similar causes, and if to this is added dear material, and discriminating rates for carriage, our local iron industries are doomed.

The economic laws that apply may be slow to act, but they act as certainly as laws of nature. Cheaper fuel and material may not alone be enough to cause prosperity, but these are primary and principal. Other conditions of success will follow if this is attained.

It is easy to see that the custom taxes on iron and fuel can have no advantage for the people of this Coast, and amount to a tax levied in the interest of older and richer states that have no need of such aid, states that do not even furnish a market for the products of this Coast. Our machinery and agricultural products must be sent out into the neutral markets of the world to compete with all nations, while our imported iron and coal cannot be bought on the same terms, nor from our own customers, without a heavy tax to be paid for the benefit of the Eastern States.

California, by a false and unnecessary policy, has been ground "between the upper and nether millstone," and it is time to dispense with sentiment and consider self preservation. The lack of growth in this City during the last decade was an anomaly when considered in connection with its environment and the circumstances of the country. Some of the impediments to growth are now becoming known, and among them the high prices of fuel and iron. These enter into nearly all kinds of industry and manufacture, if not indirectly, directly, and at this day cannot be offset by skill, tariffs, or in any other manner.

PROPERTY IN INVENTIONS.

BY COL. F. A. SEELY, A. M., PRINCIPAL EXAMINER U. S. PATENT OFFICE.

The convenient phrase Industrial Property, recently naturalized into our language, comes to us from the French, who are more apt than we in finding terms to express generic ideas. It does not include all property employed in industry, but only incorporeal property related to production and trade, and has its analogue in the phrase Literary and Artistic Property. The latter includes the property of the author and artist in the productions of their labor and genius; such, in fact, as we usually define by the term copyright. Industrial property includes a wide field of incorporeal rights, such as are embraced in mechanical and design patents and trade marks, including many for which the English language scarcely has names. The phrase Good-Will is made with us to cover a number of rights constituting a sort of property, for which the French have specific names and a place in their jurisprudence.

For an occasion like this I shall not attempt to traverse so wide a field as implied by the title assigned to me. The general acquiescence of the commercial world in the sentiment that the name and trade-mark of a manufacturer are his property under the law of nations, long proclaimed in Europe, makes their international protection comparatively easy. It has been accomplished by treaty stipulations in many instances, in others it has been conceded without question as a common law right. In few cases, except where shameless piracy of trade-marks is countenanced by a corrupt trade morality, is there serious difficulty in securing their protection. There are some differences in definition yet to be adjusted, some minor obstacles to be removed, but commerce is wielding its mighty influence to bring the nations of the world into constantly closer relationships, and to throw down the barriers that civilization and Christianity have found hitherto insuperable. Everything leads to the belief that before long the international character of this kind of property will be completely recognized and full protection accorded to it in all commercial nations. Dismissing, therefore, this branch of the subject, I shall consider briefly the history of International Protection for Mechanical Inventions and its present aspect from an American standpoint.

The world was very slow in coming to the notion of Industrial Property. No trace of it exists in ancient laws or customs. Athens could reward with a laurel crown the originator of a new idea in art, but could not conceive that he possessed any rights in its exercise. In Sparta industry was scorned as the lot of a slave, whose rights were systematically crushed. In Rome the laborer had neither rights nor property, and in the systems of law derived from Rome there is no recognition of the rights of inventors or artisans. During the dark period of the Middle Ages many indus-

tries flourished, but under the restrictions of the feudel system, and the more oppressive tyranny of trade corporations, the personal rights of the artisan were lost sight of. When even the right to work was a privilege, accorded by favor and hampered by arbitrary and cruel regulations, the notion of a property-right in an invention, or an improvement in the arts, or a trade-mark, was inconceivable.

Under the fixed rule of the Guilds the introduction of a new improvement was next to impossible, and the marks affixed to merchandise to indicate its origin were property in about the same sense that the brand and chains of a convict are his. They served to point out the producer of merchandise in order that if it failed to come up to the required standard the harsh and irrational penalties which the times permitted might be visited upon the proper victim.

It is not till the darkness of the Middle Ages has passed, and the more reasonable ideas of modern times are gleaming in the horizon, that the notion is evolved of remuneration to the inventor of a new and useful art. Under the Tudors in England, among other privileges that flowed from royal favor, the exclusive right was sometimes accorded to exercise within the realm the entire industry in which the beneficiary had made a useful improvement. Such privileges, going by grace rather than as of right, were allied to the mass of other privileges and monopolies which were slowly crushing the life from English industry.

Two years after the landing of the Pilgrims on Plymouth Rock the first step in the history of the world was taken towards the recognition of Industrial Property by the enactment of the law of monopolies of James I, which abolished privileges while reserving to the Crown the right to grant patents to the authors of new and useful inventions. It would be a mistake to assume that the sentiment expressed in this law recognized a right of property in an invention. The patents granted under it still flowed from royal favor. They were less arbitrary than the privileges which preceded them, since they were granted for limited times, and the monopolies they created were restricted to the enjoyment of the new invention of which they were the object. For this reason they ceased to be an obstacle to industry, but became the reward of the inventor, and laid the foundation for the vast industrial supremacy Great Britain has so long enjoyed.

A hundred and forty years later, by a decree of Louis XV, December 24, 1762, a similar step was taken in France. The preamble to this decree recites that the privileges conferred for the purpose of compensating inventors had failed of their object, because, being accorded for unlimited time, they had become rather an hereditary patrimony than a personal reward to the inventor. Their term was therefore fixed at fifteen years. This legislation, like all before it, recognized no rights of the inventor, but left the concession to the caprice of power, and its exercise subject to the malicious opposition of the corporations. The first step toward the acknowledgment of the rights of inventors in France was in an

edict of the same king, March 12, 1776, of which the philosophic Turgot was the author, and which recognized these rights as natural and common. "God," said this edict, "in giving to man needs, and in making necessary to him the recourse of labor, has made the right to labor the property of every man; and this property is the first, the most sacred, and the most imprescriptible of all rights." This concession of the rights of labor was a wonderful one for the old regime in France; but feudalism still reared its head, and the conditions growing out of its arrogant claims, and the arbitrary power of the trade corporations, were an insuperable obstacle to the complete enfranchisement of industry.

Not many years were to elapse, but a new light was to flash over Europe from a source scarcely conceivable at that time. We may confidently claim that the Constitution of the United States, in giving to Congress the power to secure to authors and inventors for a limited time the exclusive right to their respective writings and discoveries, was the first practical and effective step in the history of the world for the recognition of property in inventions.

The act of April 10, 1790, quickly followed, enforcing the provision of the Constitution and establishing for the United States the rights of the inventor. It is conceivable that this feature of the Constitution may have been suggested in part by the French edict of 1776; but it is certain that France was prompt to welcome back the principle; and in the law of January 7, 1791, the National Assembly provided for the protection of new inventions. The preamble of this law is a noble statement of what is true in principle and wise in policy. It runs thus:

"The National Assembly, considering that every new idea, whose manifestation or development may become useful to society, belongs to him who has conceived it, and that not to regard an industrial invention as the property of its author would be to attack the essential rights of man; considering at the same time how much the lack of a positive and authentic declaration of this truth may have contributed till now to discourage French industry by occasioning the emigration of numerous distinguished artists, and by causing to pass out of the country a great number of new inventions from which this Empire ought to have drawn the first advantages; considering finally that all the principles of justice, of public order, and of national interest, imperatively command that it determine for the future the opinion of French citizens with regard to this class of property by a law which consecrates and protects it, decrees—"

The law which followed, firmly establishing the principle of property in inventions, survived in France through all her political changes for the next half century, being superseded by a new law in 1844. Meanwhile nearly all the countries of Continental Europe had enacted patent laws; and the principle, originating in the mutterings of discontent that led to the Revolution in England, carried to its full extent as the logical sequence of American independence,

and finding its foothold in Continental Europe during the feverish intellectual and political conditions of the French Revolution, has become the common heritage of the civilized world.

Those who declaim against patent rights as grinding monopolies for the oppression of the artisan may possibly learn from this history that in the economics of modern life the patent system is the first fruit of the protest of labor against enthroned and ancient privilege. It is the offspring of revolution and the very reverse of monopoly. It was created on the demand of the common people simultaneously with the overthrow of monopolies and with the establishment of civil and religious freedom. It is a perpetual token of the concession made to the rights of labor by power and privilege. In its last analysis the right involved in a patent is the right to work and to the legitimate rewards of intelligent industry ; and we wonder why the world so long refused it recognition, or that, as its nature has been better understood, opposition to it should have been maintained. But nothing dies harder than error and prejudice, and industrial freedom was only to be secured at the cost of such revolutions on both continents as have established other human rights by the overthrow of thrones and the dismemberment of empires.

There is always room for dispute about the efficacy of different systems for the protection of the inventor and for the encouragement of industry, but the truth of the declaration solemnly made in France a century ago grows ever clearer, until it is hard to find an intelligent person to dispute it, that "not to regard an industrial invention as the property of its author is to attack the essential rights of man."

The establishment among European nations of the idea of property in inventions, and of its protection by law, was at last achieved. It was a step magnificent in what it embodied, and its results upon industry, commerce and social life have passed all computation. But the new conditions which it created quickly proved that the limited protection accorded by national laws failed to a great degree of its purpose. The swift and constant intercommunication of ideas, to which national frontiers were no barrier, carried the improvements in the arts made in any nation to the confines of the civilized world, and for these improvements, beyond the limits of his own nation, the inventor had no rights that other nations would respect. An invention patented in one country was denied protection in others, and thus, while it contributed to promote the industries of all, protection was accorded to its inventor in only one, and was, therefore, disproportionate to the benefits the world derived from it.

Such a state of things is repugnant to human sense of justice. The same conception of the rights of the inventor that had found expression in the constitutions of the United States and of the French republic forced thinking men to the conclusion that the rights in question could not be bounded by geographic lines, but

that the protection of the inventor should be coextensive with the benefits he has conferred upon mankind. Hence the idea of international protection.

REPORT OF THE U. S. COMMISSION OF NAVIGATION.

This report, by E. C. O'Brien, makes strange reading if perused at the same time with Mr. David A. Wells' work on "Our Merchant Marine," published in 1882. It constitutes a plea for Government protection and bounties, which Mr. Wells contends was the very cause that has destroyed our foreign shipping interest.

We are unable to agree with the conclusions set up in the present report, that American shipping needs subsidies. What it requires is to be "let alone," and given an equal chance with other nations. It requires no computation to show that an American owner cannot pay fifty per cent. more for a ship, about ten times the dues and taxes required in other countries, and then operate his ships on the open seas where these protective laws cannot reach. An American vessel of 112 tons, clearing for a Canadian port within sight across the St. Lawrence River, pays Government dues of one kind or another amounting to about $40, and when she returns from there pays in Canada $2.00, or one twentieth part as much. She is taxed as personal property whether in commission or not, and harassed at every turn, until "protected" out of existence, or, as is most likely, transferred to some other flag.

The Commissioner comments upon the shipping interests of this Coast, citing the Pacific Mail Company, that is paid a heavy subsidy by the Government to carry freight for American shippers, and subsidized by the railways to not carry freight, and then, what is worse still, the Pacific Mail Company pay over a portion of this Government subsidy to a British line to keep off competition and raise the rate for American shippers, making a "mess" that just now seems about to have some attention from the people.

There is mention of the O. and O. Line, sailed under the British flag, but not of the Oceanic S. S. Co., sailed under the puissant flag of the Hawaiian Government; in both cases to escape the "fostering" effect of our Navigation Laws. As to subsidies, the Postmaster General, last year, attempted to secure bids for foreign mail service. The result need not be stated. Nine out of eleven contracts were let to one company, and there was no competition in the case,

but a combination to "beat the Government." No one will contend that any good will result from these contracts. On the contrary the effect is to cut off competition, and raise the rates of carriage for our shippers, and still farther reduce our merchant marine. Everyone interested in the welfare of this country wants to see our foreign shipping regained, but the subsidy and bounty system gives no hope of such a consummation, on the contrary leads to combinations to "fleece" the Government and shut out competition, which is the only hope of building up what has been destroyed by paternalism. The example of France, where a bounty system since 1881 has been carefully and impartially tried, shows an absolute failure in the objects in view, and a decline in shipping interests compared with almost every country where the industry is not "protected" or interfered with.

In 1881 Prince Bismarck proposed a similar system in Germany, and we cannot forbear producing here a translation of the protest of the Merchants' Society of Hamburg, as follows:

"German commerce and navigation have been able to compete with those of other nations, and their present strong position is chiefly due to their own exertions. Even if the French Government should extend larger monopolies and subsidies to their national trade and commerce, the Hamburg shipping merchants are not afraid, that, if let alone, their own development would be injured or suffer under such adverse legislation. The growth and prosperity of national trade are, before all, created by the natural talent and disposition of a people. Governmental measures, whether they consist in throwing artificial obstacles in the way of foreign competition or in direct support of the national flag, may here and there bring temporary advantages to individual enterprises, but they will never be able permanently to raise and elevate the shipping interest. On the contrary, as experience has shown in France, they paralyze individual energy, and endanger the spirit of enterprise, and effect the decline, if not the ruin, of trade. In the interest of German commerce and of the national flag, the Hamburg merchants most earnestly and respectfully pray that all governmental measures for their protection be definitely set aside."

No such laws were passed in Germany, and one has only to look back over the history of German and French shipping since 1881 to see the wisdom of this sagacious conclusion.

Ship building is flourishing when ships are wanted, and we must either confine this important industry to the wants of our inland commerce, or else place American owners on a basis to compete with other nations on the high seas.

LITERATURE.

Hand-Book of Tables for Electrical Engineers.

Messrs. John A. Roebling's Sons Co., of Trenton, N. J., have, on several occasions, issued printed text books collated from good authority, that have contributed a good deal to engineering convenience, if that term be admissible. It is commonly within the power of any large company engaged in a skilled industry to command a large amount of useful data, not only in respect to the particular work carried on, but as in the present case, where an engineering staff is included in the conduct of the business, the facilities for preparing a text book far exceed the ability of any single author.

The present little work of 100 pages, published by the Roebling Company, is not a trade advertisement, indeed, has no feature whatever of the kind, unless the fact of its publication by the company is such. Its object seems to be to disseminate exact information respecting the physical laws that lie at the bottom of generating, conducting, and applying electrical energy, and the proper agents to be employed for conduction. The first chapter in the book is from "Brackett and Anthony's physics," and is a fitting introduction to any book dealing with technical subjects. Some of the paragraphs are striking, the one on measurements is as follows:

"All the phenomena of nature occur in *matter* and are presented to us in *space* and *time*. Time and space are fundamental conceptions; they do not admit of definition. Matter is equally indefinable; its distinctive characteristics is its persistence in whatever state of rest or motion it may happen to have, and the resistance which it offers to any attempt to change that state. This property is called *inertia*. If we adopt arbitrary units of length, time, and mass (or quantity of matter), we can express the measure of all other quantities in terms of these so-called *fundamental units*. A unit of any other quantity, thus expressed, is called a *derived unit*."

In respect to units of quantity, one will be struck by the claim here, we believe for the first time put forth in this country, that the scientific units for length and weight are metrical, as follows:

"The unit of length usually adopted ie scientific work is the *centimeter*. It is the one-hundreth part of the length of a certain piece of platinum, declared to be the standard by legislative act, and preserved in the archives of France."

"The unit of mass in the United States is the *avoirdupois pound*. The unit of mass usually adopted in scientific work is the *gram*. It is equal to the one-thousandth part of a certain piece of platinum, called the kilogram, preserved as a standard in the archives of France. This standard was intended to be equal in mass to one cubic decimeter of water at its greatest density."

Following this section of general physics begins the electric portion of the work, including, however, admirably arranged tables of a general nature. One on "the formulae and dimensions of units," that is a mathematical compendium.

The most extensive tables relate to electric resistances and losses of transmission, or as they are termed, "wiring tables," the first one showing the required resistance to produce a given loss in electro-motive force, and the second to show the actual resistance of copper wire of different sizes and for given distances.

Following these are tables of strains and deflections for suspended wire, weights and other matter for reference. The book can be procured at the company's offices in this city. Price $1.00

Consular Reports.

NO. 146, NOVEMBER, 1892.

In this number one of the most important contributions is from Consul General J. M. Crawford, at St. Petersburg, on the subject of cholera in Russia. The article amounts to an able lecture on the pathology of cholera, with annotations of great value in view of the probable visit of this scourge in Western Europe, and possibly on this continent next summer. The provisions made in Russia to prevent contagion are certainly of the most complete nature possible, even in that country where a centralized government enables the application of such provisions. The regulations are directed principally to cleanliness, and food, also to prompt and careful treatment in special

hospitals of those attacked, and an inference, from this report, is that it is not likely that in any other country can more be done to guard against the disease or ameliorate its results.

A young American physician, Mr. Arthur G. Blackstein, of New York City, who had achieved distinction in his studies at the Oldenburg Institute, in St. Petersburg, was commissioned by the Russian Government to go to Baku, erect a laboratory there and conduct a series of scientific experiments relative to the cause of Asiatic cholera, and especially as to its locus in the human body. Dr. Blackstein is a graduate of Cornell University, at Ithaca, N. Y., and is a fellow of the Johns Hopkins University, at Baltimore, Md.

Consul General Crawford is evidently himself a scientific man, or else has had technical assistance in the preparation of his report. Its main conclusion is that the cholera poison must, in order to infect, be introduced into the stomach by either food or drink, and that well and carefully cooked food, and fluids that have been boiled, will not convey such poison.

Tariffs in Foreign Countries.

SPECIAL CONSULAR REPORT.

The voluminous work of more than 800 pages gives tariffs and tolls, or, in other words, revenues derived from commerce, in the principal countries of the world, and shows a strange phase of modern political economy.

Our space will not permit a review of the subject matter in the book, but instead will be given some conclusions respecting the general subject, the facts of which are here so extensively set forth.

Primarily this method of taxation exists because it is easy, indirect, and not understood by the masses in any country, also because the laws and policy of a country are usually determined by those who own property. Tariff taxes are assessed on consumption, that is, what is consumed, and not on wealth, everyone pays such taxes in proportion to their living expenses, and not in proportion to their wealth or income. A poor man who has a large and expensive family pays more tariff tax than a rich one with a small family, or who lives economically.

Whatever is purchased and sold again is not affected by a tariff tax, because the enhanced cost of the goods passes on to the next buyer, and so on to the consumer.

The result of this system of raising National revenue will be, no doubt, a revulsion against it all over the world, but during its continuance certain nations will avail themselves of the opportunity it offers of absorbing an unfair part of the profits of trade manufactures and carrying.

This Great Britain is now doing. There is a stream of tribute centering there from all parts of the world. Her trade was freed, and direct taxation instituted about forty-five years ago, and her progress since that time has placed about one fifth of the civilized world under her sway as a ruler, and nearly a half of the whole commerce of the world.

Statistics of her production are meaningless. It is her private revenues that are the great fact of that country. These are drawn from everywhere, even in this country such revenue is enormous. The investments being estimated by some at a billion of dollars, all its earnings going to London.

This is an evil of artificial prices, and other countries will in time learn the same game and some of them reap the same advantage. This, we claim, is to be one result of raising revenue by taxing commerce and creating artificial prices.

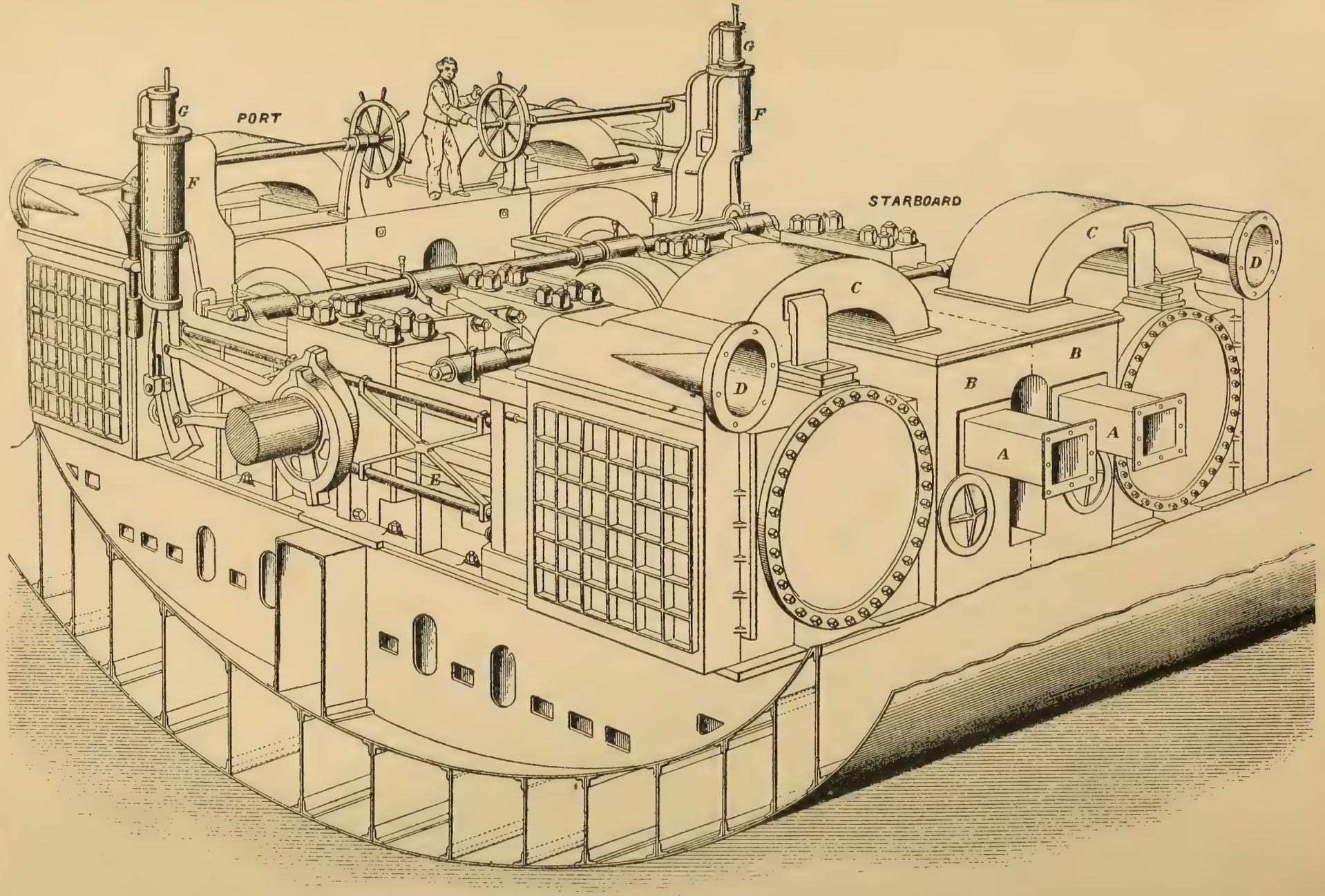
Another result of the system that is now engaging serious attention in some quarters, is the possibility of an unusual money panic due to speculation over production and unnatural stimulation of artificial prices. Such a result always follows inflated prices, credit is strained until it "breaks."

The present work is one of much value, showing, as it does, the extent to which the revenue of various countries is drawn from their commerce. As before remarked, our space will not permit reprduction of the statistics given.

Spon's Engineers' Tables.

SPON & CHAMBERLAIN, NEW YORK.

This ponderous tome has reached an eleventh edition without corresponding growth, being yet only $1\frac{3}{4} \times 2\frac{1}{2}$ inches. It contains a collection of tables for engineers and builders, within a compass so small as to be continually carried in the pocket without inconvenience. It is the smallest book of the kind ever published, made so not as a curiosity, but for practical ends, and exceedingly useful. Price, 40 cents.



SCREW ENGINES OF THE GREAT EASTERN.

[For description, see page 247.]

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"INDUSTRY."

JOHN RICHARDS, EDITOR.

ISSUED MONTHLY BY THE

INDUSTRIAL PUBLISHING COMPANY

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COMMENTS.

The National Board of Underwriters in 1891 requested the Department of State to procure from consular offices reports on fire and building regulations in various parts of the world, and a circular was issued for that purpose, calling out a series of communications that make up a printed volume of 500 pages. We do not include any notice of this work in our review columns, because no adequate notice can be given there, and instead we will once more remark upon the astonishing matter of how little good these reports do compared to what they might, if people read them. Here is a compendium of the world's wisdom in the prevention of fires, and the organization of means to quench them, of inestimable value to all who participate in this extensive department of municipal economy, and yet we imagine not one in a thousand ever heard of the report or will read it. Copies can be procured by application to the Department of State at Washington.

Senator Morgan of Alabama, in the *North American Review*, presents the Nicaragua Canal enterprise in a cogent and reasonable manner, urging the support of the work by the Government. The Senator is no doubt right, but is wasting his efforts, because the sentiment of the country is in favor of this, but looks with suspicion on the methods this far presented. A canal company, and a canal con-

struction company, composed of the same people, looks too much like a Credit Mobilier, Contract and Finance, or Western Development Company, to command confidence on this Coast, but Senator Morgan forgets to discuss this in his article. He says the railways owe the Government $100,000,000, enough to build the Nicaragua Canal, and "if we will we can use the money due us from the railways to build the canal." To this there will be general consent, but it is only words. Why does not Senator Morgan in that body of which he is a member, and where a goodly share of these railway interests belong, proceed to collect this $100,000,000, and turn it over to a canal fund?

Prof. R. H. Thurston, Director of Sibley College, Cornell University, has been writing of wind wheels, which he calls "mills," and gives some interesting facts concerning them. His eulogy of American practice in making such wheels, "which illustrate the remarkable ingenuity and practical genius of our countrymen," should be qualified with the explanation that, except a few wheels made in Dakota, none of any size or pretensions have been constructed here. He says "mills are made as high as forty feet in diameter," which is a curious corollary of dimensions, but the fact is, our practice is confined to small wheels with multiple vanes, and too often made so as to be blown away at the first gale. Here in California where we employ more wind motors than in any other section of the country there is not any but what are toys in comparison with those in Holland and other low countries in Europe, employed for driving mills and pumping. There has been a good deal of discussion here respecting the adaptation of large motors with sails for the heavier kinds of work. Sails are best for a large wheel, the same as they are best for ships, indeed the two things are analogous, and we imagine that large wheels if ever made here will be much like the old ones, which are so much disparaged in the article referred to.

We have tried to find out the point of enthusiasm over the transfer to American register of the two Inman steamers on the 22nd of February last. There was a great ado, the President went out from Washington, guns were fired, and general rejoicing over the admission of two American steamers to American register. The Inman Line is mainly, or indeed almost wholly, owned by American people, and if the causes that have hindered their register here before yet

apply, what is there to rejoice over? There is more cause for humiliation. These vessels were built abroad, and sailed under a foreign flag because of our antiquated navigation laws. On the same day of this celebration came the news of the bankruptcy of the United States and Brazil Steamship Company. This latter line received a subsidy of $100,000 a year from Brazil, also a subvention from the Argentine Government, and was about to receive a postal subsidy from the American Government. When one considers the capabilities and possibilities of our merchant marine, and its strangulation by paternalism, it is pretty hard to work up enthusiasm over the fact of American citizens raising the flag of their country over their own property.

The price of wheat in Europe, or in Liverpool, which is the same thing, fluctuated wonderfully during 1892. A diagram published recently in *Industries*, London, containing the price given for January 1892, thirty-six shillings per quarter. Assuming this as 100, the ordinates of the diagram show the decline as follows:

Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
100	88	90	83	88	82	80	81	79	77	75	70

This shows a decline of 30 per cent. during the year, and placing the crop of California at 30,000,000 bushels, and the value at $1.00 per bushel, the loss will be equal to $9,000,000. The causes of fluctuation in the prices of breadstuffs are many, and to act in this astonishing degree must be concurrent. Wars, a general failure in crops, and the general state of business are predominating causes. This great decline in resources has come upon the farmers just at a time when there has been an increase in the price of nearly all they consume, and the result must be most disastrous when, as in many cases, their land is encumbered with fixed charges for borrowed money. The outlook is more hopeful for 1893, and there has been, no doubt, a considerable diversion of the wheat industry to other products.

The name "aluminium," euphonious, correct and established, has been for a long time disturbing the "word butchers." Those who "locate" things and take "lunch," but not "din" or "break." Pages have been written on the subject of aluminium, but for what cause no one can see. A want of information respecting words and terms is commonly concealed by slang, the speaker or writer supposing the hearer will construe terms, misapplied through ignorance,

as if used in jest. The only colorable objection to aluminium is that the name is too long. Too long for what? The discussion is ridiculous, and betokens a want of more serious and useful occupation.

INDUSTRIAL NOTES.

Mr. J. A. L. Waddell, of Kansas City, a civil engineer whose opinion we have found occasion to report a good many times in the past, has designed, for use in Chicago, a lifting bridge that is novel in respect to all plans of which we have any knowledge. Instead of tipping, swinging or withdrawing the movable span, he simply lifts it up out of the way. The bridge crosses the Chicago River, and that being a navigable stream the Secretary of War decided that the clear height should be 155 feet, so the bridge when opened will soar up into the air that distance if required. It seems anomalous to clear a ship by going over the top of her masts when a fifth of the same movement sidewise would let her pass, but the movement does not amount to much. The bridge is counterweighted, and can be run up or down with but little effort. The main point, however, is the supporting towers at each end. These extend up 200 feet, and will cost a large sum to construct and maintain, epecially if strong enough to hold the bridge in the air during a gale of wind.

The economic place of asbestos in the arts and manufactures is becoming, at the present day, a fact of importance, especially on this Coast, where the mineral is found in a very pure state. The Pacific Asbestos Company, of Los Angeles, have works at San Diego, Cal., where this mineral is prepared, and incorporated in paints of all kinds, steam covering, refractory linings for stoves, roof material, lubricating oils and other things. The agent here, Mr. James A. Maguire, informs us that wood covered with asbestos paint will not catch on fire when exposed to flame, if the oil contained is first permitted to harden, and in proof of this we examined some time ago wood that was converted to charcoal by heat without being burned, the protection being two coats of whitewash made from ground asbestos. The fiber of this "mineral wood," as it is sometimes called, gives an adhesive nature to plastic or other compounds, a quality not possessed by any other mineral substance.

Commodore and Chief Engineer Melville proposes to determine the speed of ships in their trial runs at sea by a standard arrived at by short runs over measured distances in still water, until the relation between the revolutions of the screw and speed of the vessel is established, and then determine the sea performance by the rate of of the screw's revolutions. While this may be subject to slight error, it is less so than shore marks wide apart, or observations. It will be remembered that a muddle arose over the tests of war vessels built by the Union Iron Works, and tested in Santa Barbara Channel. The speed of a vessel is a resultant of her power qualified by resistances that are neither constant nor measurable, such as currents, wind, and state of the water, so that after all horse power becomes the best exponent of speed, and if ratio between power and speed is once determined the number of the screw's revolutions is a better measure of performance, than observed distances run in a given time. The U. S. Cruiser *Bancroft* has been tested according to this method, and the result, so far as known, is satisfactory in every way.

Mr. James D. Schuyler, C. E., formerly of this City, at the December meeting of the American Society of Civil Engineers, read a paper on "Lining Reservoirs for Water with Petroleum Pitch, or Asphaltum," such as is plentifully found in the southern sections of this State. The facts adduced, of which there were a good many, all point to the success of the method, and it should engage attention here, especially for small reservoirs not lined with masonry. The element of elasticity, possessed in a high degree by this material, is much in its favor. Of course the work must be kept perfectly dry while in progress, and this far is at some disadvantage compared to hydraulic cement, and there is the further impediment that while asphaltum pitch is sure to become more expensive in future, concrete mixtures are as sure to become cheaper. Mr. Schuyler recommends a combination of the two. The paper will be published before long in the transactions of the Society, and is one that will have interest here.

Mr. J. C. H. Stut, a well-known engineer, in this City, who designed several of the largest power plants for cable railways here, has recently been giving some attention to methods of combustion, and has developed some facts that are decidedly novel. Mr. Stut has promised, at an early time, to present an analysis and explanation, and we will, at this time, only say that his experiments point to a wide

distinction between chimney draught and forced draught, or to certain relations between these when combined, and indicates limitations of chimney draught that have not been suspected. To state it broadly, the air for combustion does not require draught and attenuation, but "compression," in a combustion chamber, so that high chimneys and a strong induced draught is by no means an economical method of supplying air to furnace fires. Mr. Stut combines induced and forced draught in various relations, noting the effects with and without compression in the furnace.

The deep-waterway convention, held in Washington, D. C., on the first of the year, would have strengthened their resolutions by omitting the "jingoism," but as it was, this meeting will aid in bringing to notice a very important matter, that of connecting the lakes with the Atlantic Ocean. Lewis M. Haupt, who, perhaps, more than any other engineer in this country, has studied this canal matter, gave his estimate, roughly made, that the cost of such a canal will be 75 millions of dollars. This, while it seems a vast amount, would only be as much as the pension list amounts to in six months, but we fear the estimate is much too small. There is now before Congress a bill, reported upon favorably, authorizing the Secretary of War to have surveys and estimates made, but the extraordinary expenditures of the last four years, and present depleted state of the Treasury, will, no doubt, defeat in Congress any measure looking to such appropriations for some time to come. The fact is that for twenty years past the country has been wandering away from the public spirit that promotes public works of this kind.

The art of constructing dredging machines seems to be making much progress at this day. A dredging boat recently constructed in England for use in Bombay, India, raised 6,000 tons of material in one day, and deposited 5,000 tons of it four miles away. The hopper of this dredging machine holds 1,000 tons. Other notes taken show 93,000 tons raised and carried off in 136 hours, and at another time 112,000 tons in 105 working hours, carrying the material in each case four miles to deposit it outside the harbor. The cost of raising and depositing spoil during the past year was in this case three cents per ton, or, counting the weight at 80 pounds per cubic foot, three cents a cubic yard, At this rate there would be no great difficulty or expense in maintaining deep water in any harbor that is not filled up by alluvial wash from very large streams. This low cost is, no

doubt, due in some measure to economical management, and perhaps cheap attendance, but is mainly due, we imagine, to the efficiency of the machinery employed.

We have been intending for some time to say something of the Bates' steel process, and have waited for some technical explanation of the matter. It is a method of making tool cast steel without the usual cementation and crucible processes, that is now successfully carried out here and in England. We have written to a scientific gentleman in Philadelphia, who, in answer, sends the following remarks :

"I was much interested in the Bates' steel process described in the news slip you sent me. I have never heard of it before, but it certainly seems perfectly possible that it should be all true, as it is only a curious inversion of the order of the old processes for making cast steel. Instead of first carburetting wrought iron in the cementation furnace, and then fusing the produced shear steel in crucibles to make it homogeneous and free from slag, this process takes the Bessemer steel, which has been already made homogeneous by fusion, and puts it in the cementation furnace until it has gradually and with certainty absorbed the additional amount of carbon necessary to convert it into tool steel. Whether it produces the gas bubbles throughout the bar as wrought iron does in forming "blistered steel" by cementation is not mentioned in the account, and would be a very important question in its value. I should think the "open hearth" steel furnace more likely to succeed ultimately in making any grade of steel wanted."

The tests of timber now being conducted by the Forestry Division of the Department of Agriculture have developed a good deal of interest, and is about the only thing in connection with forestry that has done so. The American people are not much concerned in anything that requires an age for fruition, and while there is a little enthusiasm over timber growth as an abstraction, there is no real practical interest in the matter, and the subject languishes as it has done in this State. It requires a dearth of timber to call out practical work, and even then the returns are so far off that the whole passes as an idea. Not so with the strength of timber, this is an engineering subject of today, entering extensively into works of various kinds, and data relating to strength if not wholly wanting is vague. The tables for fir woods will, no doubt, be published before long, and will be welcome on this Coast, where timber structure is the rule. Douglas or Oregon fir, so extensively used here, is one of the varieties dealt with, and we predict that its strength will be a surprise to people in the Eastern States.

LOCAL NOTES.

William Dickie, Esq., father of the Dickie Brothers, ship builders of this City, died at San Mateo at the home of Mr. George W. Dickie, on the 25th of last month, at the advanced age of eigty-six. Mr. Dickie, senior, was also a shipbuilder, as the family has been for many generations back. We propose in our next issue to say something on the influence of his long industrial life, or rather the lesson of it, much needed at this day.

The removal of the Capitol of California from Sacramento to San Jose is a proposition of some importance. The local and personal considerations involved, which in modern methods of public business seem to be the main thing to be considered, can be left out. There will be a large loss of money, if not to the State to someone else, and that the most of it will in the end become a charge on the public funds no one need doubt, but there are certainly countervailing advantages. At present it requires about five hours for the railway to carry passengers between the commercial and political centers of the State. The distance is only 80 miles, or so, and no grades, but that avails nothing. By a route on the bay shore, which seems a possibility of the near future, because commercially expedient, one can go, or ought to go, to San Jose in 60 minutes, so the facilities of this City would, in a great degree, become available. As to a million dollars and ten acres of ground being furnished as a bonus for removal, there should be no such consideration involved, and no reason for it. The State can buy such ground as is required, and can build its own offices without being placed under a questionable obligation. It is a kind of bribery that is undignified and unnecessary—a deferred claim only.

It is difficult to understand the scheme on which the present wharf now building at Santa Monica is based, unless it is to definitely determine a port for the southern end of the State. The wharf is 4,000 feet long at the present time, with nearly another 1,000 feet to be added. The width is 130 feet, sufficient for seven pairs of rails. The water now is 38 feet deep at the extreme end, and a gain of seven feet more will be attained by extension. Any temporary structure with only capacity for present use would have conveyed an

impression of experiment, with the possibility of change, but a work of this extent, connected inland by diverging railway lines, will constitute a port not to be moved, and settle a problem that has been open for a good many years. The Southern Pacific Company, with their connections, have ample power to determine a southern port for California, and it has been done by this work at Santa Monica.

The *Stockton Mail*, of Feb. 24th last, describes the successful working of a ploughing engine, operating on soft tule lands at the rate of ten acres a day, which is remarkable, and if possible there should certainly be no impediment to ploughing dry lands by steam. The traction engine in question is mounted on very large bearing areas. The main traction wheels are of wood, and only one fourth the weight of iron ones of the same size. Other elements are made as light as possible, and from the description there seems to be no other feature of novelty in the engine, unless we consider as such the fact of its drawing plows on marsh land over "nigger heads" and tule growth. As before remarked, when such lands can be tilled by steam traction, there should be no problem in other cases, but there is such a problem, and one that, as Mr. Gladstone would say, is within "measurable distance of reasonable success," and the principal impediment is just the circumstance most prominent in this case, the softness of the ground and the disposition of the engines to bury themselves.

The *Engineering and Mining Journal* in speaking of the California State Mining Bureau and the method of its management, says that "politics, which impaired the usefulness of the U. S. Geological Survey, has here been destructive. Appropriations secured by political influence were spent in conciliating those whose votes would secure other sums. Counties whose interests are agricultural, and whose mineral resources were unimportant, were thoroughly explored, and favorably reported on in order to secure the influence of their legislators." We would be very glad to contradict these statements, but fear they are based upon substantial facts. The reference to the U. S. Geological Survey is timely, and has some verification in efforts now being made to secure, in this State, a legislative act granting money to be employed in connection with the work of the Government Bureau. The Mining Commission is, perhaps, the most important of all among the various ones appointed in this State, and capable of rendering important service, but whenever it is

conducted for personal objects, and with reference to securing appropriations, it is time to consider its reform or discontinuance. What is required seems to be an act of Legislature compelling returns to be made showing the condition and working of mines, and a secretary to collect and prepare such reports for publication. The Yosemite, Railroad and Forestry Commissions, with Commissions in general, will, no doubt, be looked into with more care in future.

The Mechanics Institute, in this City, in their late election for officers, employed what is called the "preferential" system of voting, which has a strong flavor of common sense and fairness. The instructions on the ticket, which contains thirteen names, were as follows:

"Seven Directors to be elected. Vote for seven candidates only.

Number them in the order of your preference; your first choice mark 1 in the space on the left of your candidate, your second choice mark 2, your third 3, and so on to your seventh."

This is perfectly clear as to mode, but is rendered obscure by a long circular of "explanation" issued with the tickets. The seven out of thirteen having the highest quantity expressed in the numerical "coefficients" opposite their names are declared elected. How far the system may be applicable in a general way will perhaps require experiment, but one thing is certain, it cannot be so bad as the two-party and "straight-ticket" methods heretofore in vogue.

The consolidation of the Fay and Egan Companies, makers of wood-working machines, at Cincinnati, Ohio, is a historical and economic event of much importance. These two are the most extensive establishments in the world engaged in this business, and consequently the new organization will be more than twice as large as any other. The organization and division of labor and service, enabled by this vast business, will have a wide influence on the industry. It is concentration in this business, which is not uniform enough in character to permit combination, that is, wood-working machines vary so much in quality and prices that no uniform price list has been possible, and the present coalition has no object of the kind, being merely a commercial problem of organization. The officers of the Egan Company become the executive members of the new board of directors, with Thomas P. Egan as chairman or president. We hope to furnish, at a future time, some statistical information respecting the works and the extent of their operations.

However pleasant or incumbent it may be, we seldom find space to acknowledge the claims of our contemporaries, but the present number of the *Woodworker* for February demands room to say that it is the most useful journal devoted to a great industrial interest that we can refer to, and there is no doubt that a great share of the progress seen in wood conversion is due to its influence. So extensive an interest lying almost without the pale of mathematical and scientific treatment, consequently lacking those powerful aids brought to bear in other branches, has nevertheless made equal advances. How much has been contributed by its literature no one can say, but that it is a great deal no one will doubt. The diversity of both material and uses is so great that this too has been an impediment not found in other kinds of machinery and processes.

Optimism is the "stock in trade" of modern journalism. People want to be happy, and should be perhaps, but the system runs out. It is pleasant to be told how prosperous and happy all things are, how industries flourish, and general prosperity reigns, but such views are a bar to progress, and untempered by cold truth soon run their course. The useful man is a grumbler, one who not only detects faults but has concern in their removal. This unselfish spirit, that has commonly no hope of reward, constitutes the real leaven of progress and reform. Useful criticism must, of course, be circumscribed by truth, which is, after all, the very matter we are driving at. It is tiresome, or worse, to read over page after page all colored to please the reader and convince him he is far in advance of the whole world. It is also profitable to do so, but in the time of difficulty the man of truth is sought out like a physician, to apply a remedy. The optimist then becomes a "humbug."

ELECTRICITY.

NOTES.

There seems to be for a world's fair a good deal of the "provincial" about the managers of that enterprise. The last movement under that head is closing the exhibition at seven in the evening, so the electric exhibits will be "cut out," so to call it, and the evening sessions, the best of all, be omitted. The Sunday closing will, no doubt, be supplemented by the "mid-week sabbath" invented out

here, if that new holy day should travel so far as Chicago. Mr. Leonard Pope, in writing upon this matter of evening closing, says he hopes the lighting companies will protest against it to the extent, if necessary, of not exhibiting at all. There may be good reasons for evening closing, but it is too late to consider them now. It is not the popular idea of the matter, nor will it suit a good deal that has been done with the understanding that the buildings would be open in the evening.

The study of physics has little credit among the agencies that lead up to practical progress in the arts. The distance is so great between observance of phenomena, and its practical application, that connection is lost sight of. Present investigations respecting a universal element, whose motions develop sound, light, heat and electricity point to an early understanding of some mysteries of nature that may widely effect human conditions. The present hypothesis respecting this element is plainly set forth by Mr. F. S. Walker in an article in the *Electrical Engineer*, London, in which the present remarks occur :

"As far as the writer is able to understand the matter now, electricity is simply the motion of the molecules of the different substances which are the subjects of electrical action, just as heat, light and sound are, and the only difference between these forces is the rate of the motion. The motion of sound, as we all know, is comparatively slow ; that of heat and light is very rapid. That of electricity would appear to be somewhere between the slow motion of sound and the rapid motion of the heat waves, whose motion is slowest (that is slower than that of light). And it would appear that the wonderful adaptability which electricity shows for every kind of work is due entirely to the position which its rate of motion occupies in the scale of the energies. It would also appear that the reason this wonderful agent lay dormant for so many ages, and is even now only partially developed is, very largely, at any rate, because we have no sense which corresponds to the particular periods of vibration comprised within the electrical range."

The electricians, if not careful, will convert the subject of nomenclature in their art to a burlesque. Everyone who has opportunity seems to take a part in the invention of names. A foreign journal thus criticises some recent propositions as follows :

"They want a unit of 'magneto-motive force,' and one of 'magnetic intensity,' which appears to be induction. 'Magnetic reluctance' is, fortunately, preferred to 'magnetic resistance'; it is a pity they adhere to 'magneto-motive force' for a quantity which is not a

force but a potential. They also speak of the 'metre candle' and 'foot candle,' when they mean candle per square foot or square meter. 'Current strength' appears for 'current.' Attention is called to these points, which would in ordinary circumstances be trivial, because in connection with an International Congress scientific accuracy is of the first importance. With most of the recommendations electrical engineers in this country will cordially agree. 'Voltage' is really a barbarous word, which is quite unique in its termination, and is therefore unsystematic. 'Diphase' and 'triphase' are common, but inaccurate. Why not double-current and triple-current? The exact meaning of the word 'phase' is seldom understood. The word comes from astronomy. If a planet had two or three satellites we should not say they were diphased or triphased, we should say there were double or triple satellites, or two or three of them. It is thus simpler to talk of double and triple currents."

Some one has introduced a bill in Congress to limit the claims of patents when they are "broad and dominating." The immediate object is, no doubt, to seek relief from Mr. Edison's claim upon the carbon filament of incandescent lamps. There is not one person in a thousand who remembers the history of this invention who does not believe it to be original with Mr. Edison, and while the public, as well as infringing makers of the lamps, have a great interest in guarding against any misuse of the patent, there is no way of defining when such a claim is "broad and dominating." It is nonsense to deal in such vague terms. If there is to be abuse by monopoly in such cases, it can be remedied by imposing certain definite conditions of manufacture that are ascertainable, such as the profits and the facilities of supply. It is these that concern the public.

MINING.

NOTES.

Senator Stewart has, by some collected statistics as well as opinions of experienced mining men, shown that the cost of producing silver is from $1.50 to $2.00 per ounce, which nobody will believe. By certain economic laws, which any amount of such computation will not disturb, the cost of silver is less than what it sells for, or else it would not be produced, and the fundamental cause of its price is the producing cost. The lost work that comes from the common propensity to speculative ventures cannot be charged up to silver

production any more than if such loss came from duplicity, as it often does in selling mines on false representations. This singular showing of Senator Stewart, produced as an argument in favor of free coinage, will not in our opinion promote that object, but on the contrary will act like the proverbial "boomerang," that reacts upon the thrower. Most everyone is willing to concede the mysteries of what is called monetary "science," a science without figures, but when it comes to showing that people will go on producing a commodity that costs more than it sells for, credulity is overtaxed.

A decision, recently rendered in South Africa by the Attorney General of the Transvaal, impeaching the broad construction of the MacArthur-Forest cyanide process of gold extraction will, no doubt, lead to some closer scrutiny of the claims in this country. The defendants in the case above named, instead of employing finely divided zinc in precipitation, use instead, sodium amalgum, which, however, seems to be a wide difference and leading to different results. It is called the Malloy process, or conducted under a patent of Malloy. A suit over the same controversy is pending in England. One view of the matter is to say that all useful inventions are attacked by infringers, and such fact proves the value of the invention, but when, as in this case, a better result is attained by the employment of a new and different element, the original patentees must assume the risk involved in all inventions, that of farther improvement by others. We are not aware of the actual royalty collected by the MacArthur-Forest people, but it is, no doubt, as usual, enough to destroy the patents.

Taken all in all the acceptance of a bond from a mythical guaranty company, in the late suit of Mr. W. Fox and the Hale and Norcross Mining Company, is the most farcical procedure that has happened in the courts for a long time. It is discouraging. The fact of another decision in the Supreme Court, declaring such a bond insufficient, would be a relief if people did not expect some other ruse to supplant the first one. It was decided that "the Legislature never intended that a corporation with a paid-up capital of $100,000 should be accepted as a surety on a bond or undertaking in an amount many times in excess of its capital." It did not require a Supreme Court decision to elucidate so simple a matter. The obligation in such a case is a money one, and governed by the same

rules as any other business matter involving the liability of corporate bodies under the statute, and how anyone could suppose otherwise is a mystery. Other circumstances of the case are too well known to be again explained.

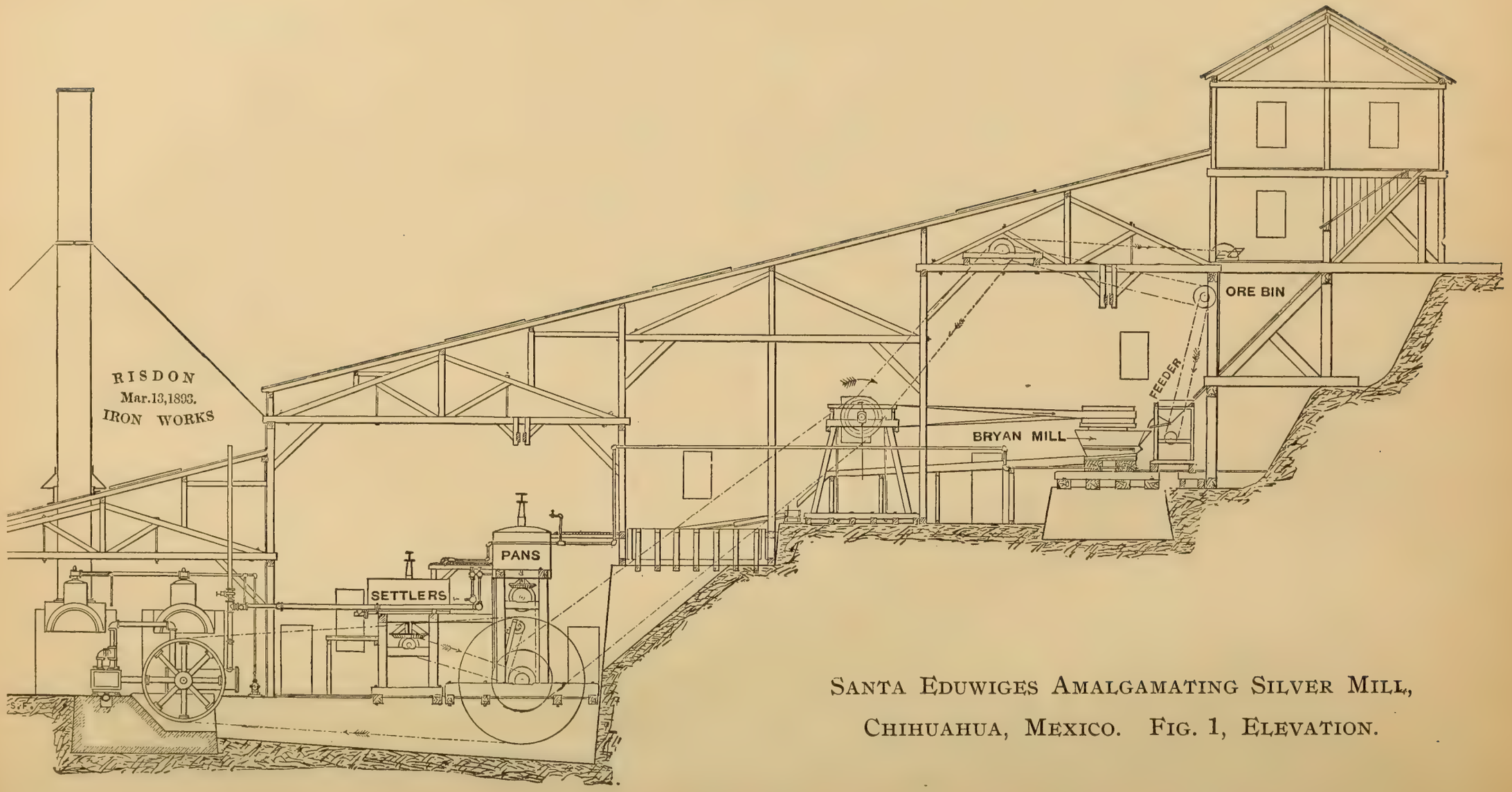
The "black-sand" business, as it may be called, is likely to experience a revival by reason of a new process of treatment or extraction, invented by Judge Brisco, of Washington. The *Mining News*, of Seattle, reports that various companies along the coast have arranged to operate on this new method, whatever it may be, and pay a royalty of one sixth of the product and five cents per cubic yard of magnetic sand treated. Unless there is some mistake in this last statement the inventor's emoluments will not be oppressive. A cubic yard of black sand, such as is collected for gold, is a good deal for five cents, and is not easy to measure. We are obliged, from the past history of this industry, to question the success of new processes, still the auriferous value may permit such. Hereabout there has been more hope of iron or steel than of gold from black sand, the deposits around Santa Cruz being extensive enough to permit its collection for smelting purposes if suitable furnaces could be devised.

The decline in the price of silver, and consequently in silver mining, has naturally directed both capital and energy to gold mining, so that this industry at the present time is in what may be called a prosperous condition. This is especially true of Montana, where the market for machinery and mine supplies is supplied mainly from Chicago and other eastern centers. The same remark as to prosperity applies, however, in less degree to California, where gold mining is in a fairly prosperous condition.

Mr. Albert Williams, in the *Engineering Magazine*, quotes from a daily newspaper the following astonishing bit of mining news:

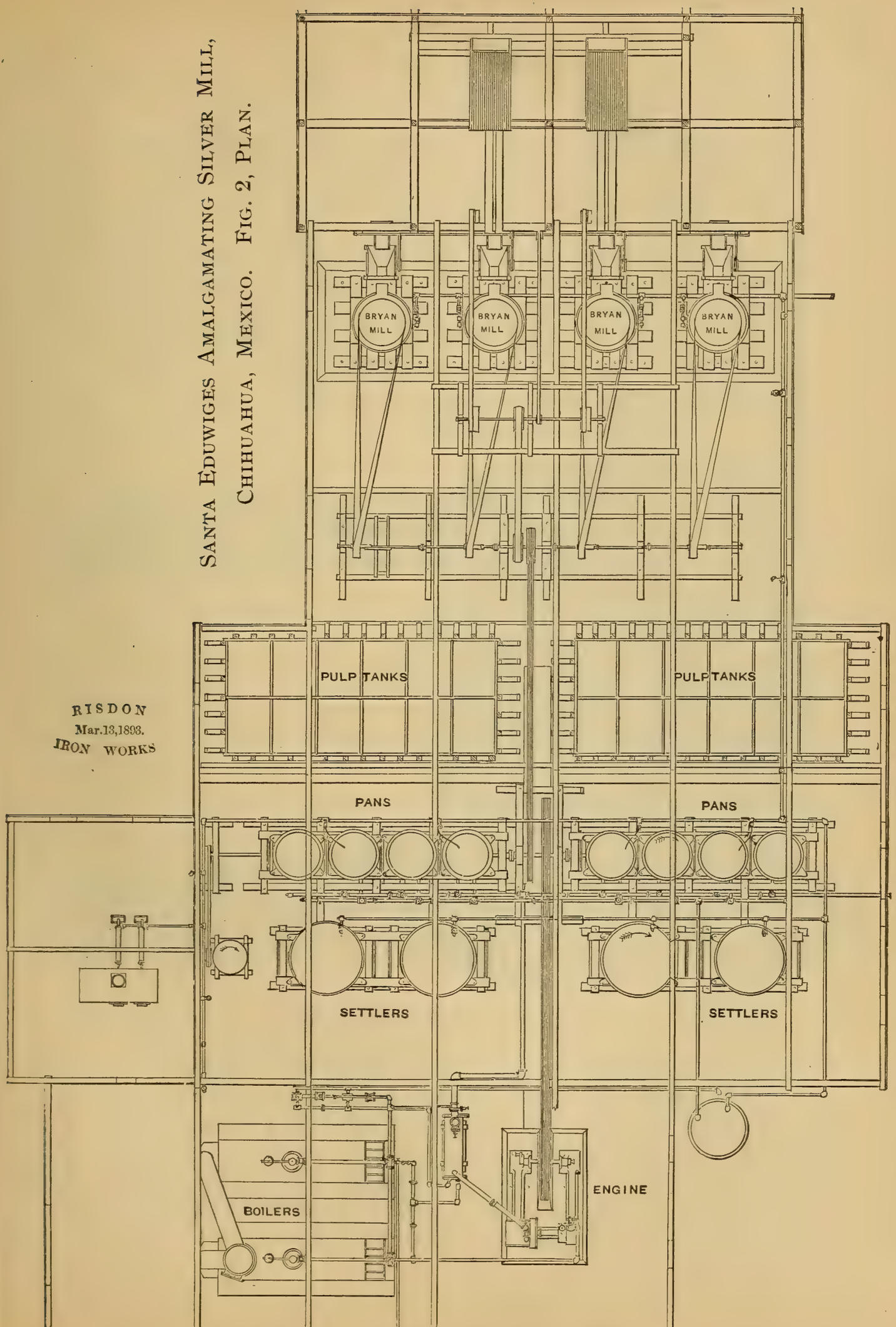
"The famous Iguana mines near this city have again gone into a bonanza, and the owners have a vast fortune of ore now in sight. Bonanza vein lies in an almost horizontal position five miles in width, carying gold ore to the value of $150 to $200 per ton. The foot walls often are from eight to ten feet in diameter to ten inches in depth, in which the richest of ore is found, running in value from $2,000 to $3,000 per ton."

The report came from Lampassas, Mexico.



SANTA EDUWIGES AMALGAMATING SILVER MILL,
CHIHUAHUA, MEXICO. FIG. 1, ELEVATION.

SANTA EDUWIGES AMALGAMATING SILVER MILL,
CHIHUAHUA, MEXICO. FIG. 2, PLAN.



RISDON
Mar.13,1893.
IRON WORKS

AMALGAMATING SILVER MILL, SANTA EDUWIGES, CHIHUAHUA, MEXICO.

BUILT BY THE RISDON IRON WORKS, SAN FRANCISCO.

The engravings on the two preceding pages show a plan and elevation of a new pan-amalgamating silver mill, constructed by the Risdon Iron Works, in this City, for the Tabor Mines and Mills Company, Santa Eduwiges Mines, in the Jesus Maria District, Chihuahua, Mexico. It corresponds in nearly all respects to a very succesful mill recently built by the same company for the Candelaria Mines, San Dimas, Durango, Mexico.

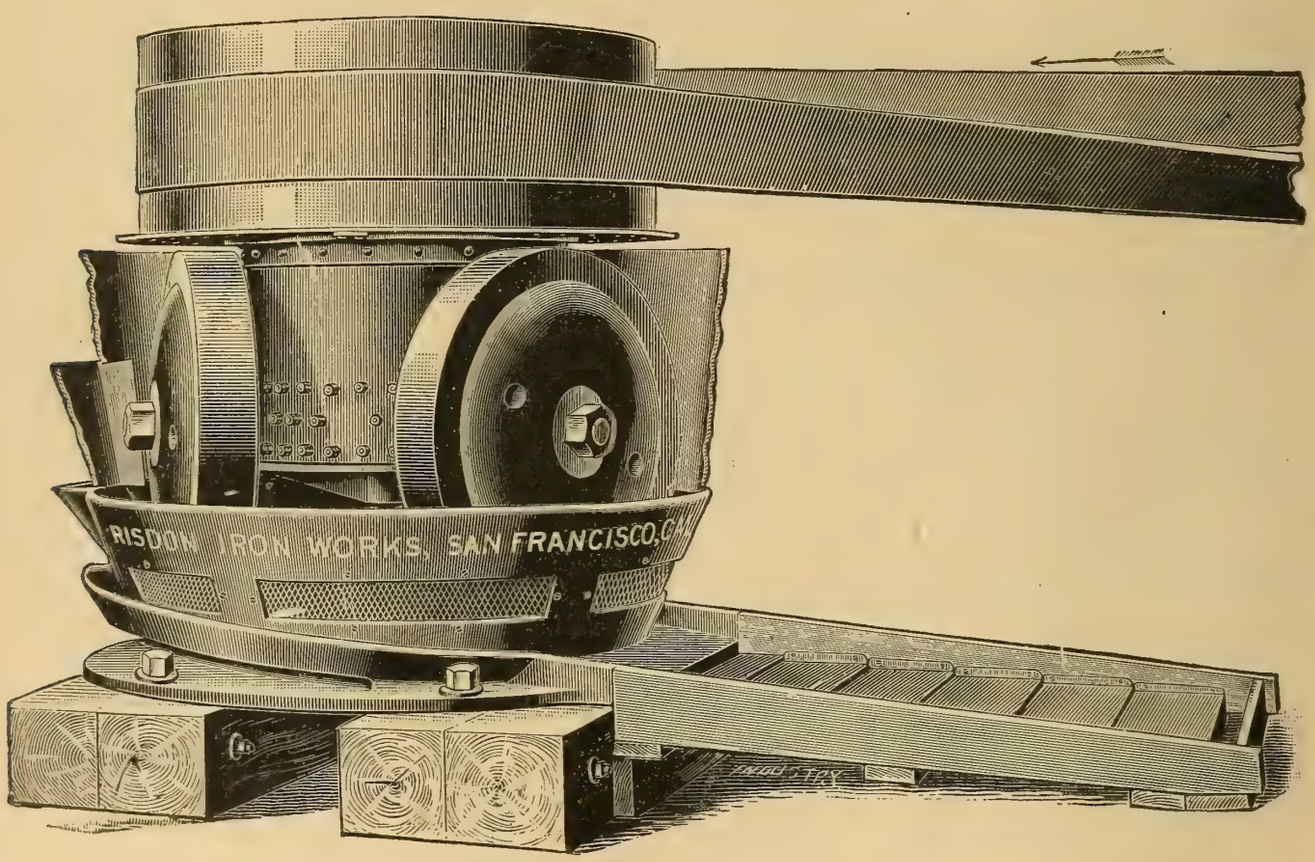


FIG. 3. BRYAN ROLLER MILL.

The present mill has a capacity of treating from 60 to 100 tons of ore daily, and except the Candelaria Mines, which has the same capacity, is the largest installation of the Bryan roller mills for crushing that the company have erected.

The motive power consists of a compound Corliss engine with cylinders 12 and 20 inches diameter, 22 inches stroke, sufficient for four 4-foot Bryan mills, eight 5-foot pans, and four 8-foot settlers,

with other details of the mill requiring power. The boilers, two in number, are tubular, 54 inches diameter, 16 feet long.

The Bryan roller quartz mills, shown in Fig. 3, are a main feature of the plants named. These machines have been a specialty with the Risdon Iron Works for ten years past. More than fifty plants have been supplied, with uniform success. A full description of the technical points involved in their operation would exceed the space at command, the following from the Company's printed matter will, however, furnish the main points in respect to the advantages of this method of crushing :

"The old Arastre which probably was used earlier than stamps, is still in use in its crude form, and in many instances considered superior to new and improved machinery. The Arastre "did the work" and did it well — and so did the Chilian mill, which may be considered developed from the Arastre. But greater capacity was required, and as the stamp battery at that time was the only machine arranged for continuous crushing, it took the lead, as its capacity was so much greater. As for amalgamation, the principle of the Arastre and Chilian mills was considered superior to stamps. Many different kinds of roller mills were tried, but they were too complicated and difficult to keep in repair, and the oil could not be prevented from dropping into the pulp, which made the quicksilver unable to amalgamate with the gold. It was after many years of experimenting, and at considerable expense, that the Risdon Iron Works were able to so improve these machines that they now have all the advantages of the crude Arastre and Chile mill, and at the same time possess the simplicity and durability that is required in mining machinery."

The method of driving these mills by a direct band and without gearing. The extended screen surface, with other of the main constructive features, is shown in the drawing, Fig. 3. The drawings of the complete plant are also clear, and do not require detail description.

For general comment, we will say that among the extensive contributions to the mining industry, by engineers and mechanics on this Coast, the most important have been in simplifying and cheapening the cost of mills, and at the same time increasing their capacity. Makers all over the world have been kept on a strain, so to speak, in their endeavor to compete with methods here, which have followed a course of evolution so rapid that notwithstanding the heavier California machinery, and the greater cost of its construction, a large share of this work has been held against competition. The mill illustrated is an example of this simplicity and economical con-

struction. The investment divided by tons of ore crushed will no doubt show a result not often attained. At the Candelaria mill one man, a common laborer, attends the whole crushing plant, reducing from 60 to 100 tons daily.

CALIFORNIA MACHINERY EXHIBITS AT CHICAGO.

The Golden State and Miners Iron Works of this City, completed, and sent forward the first of last month, a Thompson's engine of 250 horse power that is to drive a portion of the machinery at the Chicago Exhibition, and we think it safe to predict that among all the engines listed for use there, the San Francisco one will have the most elements of novelty, both of general design and detail.

The engine is a tandem compound with cylinders 12 inch, and 22 inch diameter, 30 inch stroke, to run at 120 revolutions per minute. It is of the automatic cut-off type, fitted throughout with slide valves, and in this most important feature will, no doubt, be the only one of the kind exhibited. All the valves of both cylinders are operated by a single eccentric. The admission ones are opened by a claw motion, and their release determined by a centrifugal governor, the closing action being by steam pressure on the valve stems. This action is elastic and instantaneous, cushioning on the usual air cylinders, and is noiseless.

The centrifugal force of the governor is resisted by a coil spring, and the weights so mounted that the increment of their force compensates the cumulative resistance of the spring, producing isochronous action, and as the function of releasing the valves causes no appreciable resistance, regulation will be very exact. A similar regulating apparatus has been for some time in use on the engine at the company's works, giving a very satisfactory result. The company deserve much credit for their enterprise in this matter, not only in respect to the nature of their exhibit, but also in the fact of its being sent at great expense from this distant point, and in a great measure without the incentives that will apply in the case of Eastern exhibitors.

The Cahill & Hall Elevator Company have sent for erection at Chicago, and use in the exhibition Building, two of their water-balance hydro-steam elevators for passenger service. These will also be in a class by themselves in so far as the general scheme, and

especially as to counter balancing, or rather the absence of it. In all other machinery of the kind of which we have any knowledge, the surplus weight of the cages, beyond what is required to "overhaul" the machinery in descending, is counter-balanced by weights suspended on ropes or chains passing over pulleys.

In these machines of Messrs. Cahill & Hall there are no such weights employed, the surplus power of the descending movement is compensated in the hydraulic elements of the machinery, and is stored up, so to speak, and again applied at the next ascent. This is quite a refinement of practice, conducing to simplicity and safety, as well as something saved in first cost. Mr. Hall of the company has been for some years past engaged on this problem and has attained the desired result in several ways, analogous in nature but differing widely in detail and construction.

The controlling valves are also peculiar, and the steam employed to create hydraulic pressure is circulated in the main actuating cylinder, thereby avoiding loss of heat by radiation. The carriages for passengers will be finished with California woods, neat and substantial.

The Pelton Water Wheel Company will send two newly designed wheels, shrouded or covered in the manner of European tangential wheels, but with the neat novelty of glass panels in the sides through which the action of the water can be observed, the interior of the wheel case being lit up by electric lights. The designs are neat and substantial. The Company furnish the following particulars respecting their exhibits :

"Our exhibit in connection with the General Electric Company is listed for Section N, space 33, number of application 5,732, and consists of one 32-inch Pelton wheel, which will run at 750 revolutions under a pressure of 279 pounds per inch, and develop 124 horse power. It is to be coupled direct to the armature shaft of a General Electric Co. dynamo, and to be used for demonstrating electric transmission by means of water power.

Our exhibit in connection with the Westinghouse Electric Company is listed in Section B, Electricity Building, and consists of a 34-inch double-nozzle Pelton wheel, which will run at 600 revolutions under 200 pounds per inch pressure, and has a capacity of 250 horse power. This wheel is to be coupled direct to the armature shaft on the Westinghouse dynamo, to be run for the purpose of demonstrating electric transmission by means of water power."

This will be a most creditable exhibit, and one that will attract much interest, also will afford an opportunity for investigating the

Pelton water wheels, that seems to be much needed among our Eastern engineering friends.

The Union Iron Works were, some months ago, much perplexed respecting some kind of an exhibit at Chicago. They had nothing to send of a worthy kind, unless it would be a marine engine, which it was estimated would cost $75,000 to exhibit. It was finally decided to send a model of the works, which will, no doubt, be the most extensive thing of the kind ever made. It will be about 36 feet square, and represent the works complete, with vessels in dock, in the water and on the ways, and will cost $12,000 or more.

In California we have, in the narrowing field of competition, to depend almost wholly upon the skill of design for such success as is attained with engineering work. The limited market prevents organized manufacture and increases greatly the cost of construction. The price of material of all kinds is high, wages are more, and, as remarked, there is nothing to depend upon in skilled manufactures but ingenious adaptation to purpose. This fact should be, and perhaps will be, taken into account in awards made for machinery exhibits from this Coast, and results attained therewith.

ANOTHER LINE OF STEAMERS.

It has been announced at the East that the Southern Pacific Company have contracted for two steamers of 10,000 tons to be constructed by the Newport News Co., to form part of a line to be founded by the railway company between New Orleans and Liverpool. This is a very likely movement, and is based on geographical and commercial considerations that are as apparent as they are important, and the wonder is that this astute company has not sooner made a move in this direction.

Trade to this Coast, and a canal across the Isthmus of Darien, do not much affect this New Orleans enterprise, for outward freight at least. The southwestern portion of the country, the products of which should drain, so to speak, into the Gulf of Mexico, is the stake to be played for, and the result will be a war between the Southern Pacific lines and those that are now sustained by carrying the cattle and grain from the vast region west of the Mississippi River to the Atlantic ports.

We have on several occasions during three years past reverted briefly to this problem of a deep-water Gulf port at Galveston,

Indianola or Velasco, and pointed out how the Southern Pacific Company has covered these points with a net-work of feeding lines, reaching up into the fertile regions like the ribs of a fan, converging now on Houston, and ready to concentrate from there on any new port constructed on the western side of the Gulf, and until then with New Orleans as an alternative point.

It is the grandest railway scheme ever set up on this continent, not only with respect to more direct trade with Europe, but also with the east coast of South America and the West Indian Islands. The Florida peninsula, a little more than fifty miles wide, will some time be crossed by a ship canal, but leaving out this, also the problem of securing a deep-water harbor south of New Orleans, and dealing only with circumstances as they now exist, there is here a route of traffic as well assured by natural conditions as one can be, not only for freight but for travel in the winter season. We predict that the line of steamers mentioned will be founded and maintained, without subvention and successfully, if not at once at some near time in the future.

The apparent subsidence of the spirit and objects, which called out the conventions at Topeka, Denver and Kansas City, to consider a Gulf outlet for the products of the southwestern country indicates either the hopelessness of any scheme opposed to railway interests, or else temporary concessions in the cost of carriage, but the time will come when so obvious a necessity will overbear private interests and lead to action.

The attempt of the Southern Pacific Company to transport wheat from this Coast to New Orleans would have had a different termination if that company had owned a line of economical steamers sailing from there to Liverpool.

THE TECHNICAL SOCIETY OF THE PACIFIC COAST.

This Association met on the third day of last month, and the following new members were elected :

Member :

Lawrence Thomson, Civil Engineer .....San Francisco, Cal.

Associate :

Edmund McNevin, Navigator.....San Francisco, Cal.

Two applications for membership were received and referred.

The following communication from Augustus Knudsen was read, and placed on file:

To the Secretary of the Technical Society of the Pacific Coast:

SIR:—The near adjournment of the Legislature, coupled to the fact that no definite result has as yet followed from the discussion regarding the means of realizing a topographical map of California, suggest the fear of an abandonment of the project, or at least of suspending it for two years. With the aim of preventing such an issue, I venture to suggest another course, viz., that the scheme be carried out by private enterprise under the Society's impulse, if it is granted that such a map is of itself a profitable undertaking.

The Society's action could be exerted in the following ways:

1st. By naming an executive committee for the unification of labors, with powers to enlist the interest of capitalists, corporations or proprietors in the scheme.

2nd. By parcelling out the State into ten or more transverse zones from Sea to *Sierra*, each to be placed under a commissioned engineer duly authorized to raise the necessary funds by personal exertions, or pledging percentage of returns, and whose technical work would be endorsed by the Society upon photographic evidence in addition to ordinary tests. These engineers would have seats in the committee.

3d. By requiring that work begin with details, as involving possible immediate returns to the operating engineers, and also as a tribute to public opinion, and to continue ascending in rank until results were ready to be embodied into one whole, when the committee would be specially authorized to arrange and print the work.

Joseph B. Crockett, Esq., President of the San Francisco Gas Light Co., member of the Society, read the paper we reprint in the present issue, on "An Experience with a 24-Inch Gas Main." This paper admits of a strong inference in favor of lead-packed joints in metallic pipes subject to flexure or disturbance after laying, and is a very useful contribution to the Society's literature.

At the next regular meeting, on April 7th, Prof. Charles D. Marx, of Stanford University, Vice-President of the Society, will read a paper on "Some Problems in Municipal Engineering." This paper will include some account of municipal improvements in the ancient city of Rome based on discoveries by excavation in modern times, and comparison made with some problems of the present day. The paper will be one of interest. Professor Marx has the advantage of cosmopolitan views on most subjects, and a training wide and liberal enough to permit impartial investigation of a subject that cannot claim much advancement in modern times. There should be a full attendance.

OUR PATENT SYSTEM.

There seems to be a widespread opinion in this and other countries, that while our system of examinations and appeals in patent applications has many advantages in favor of inventors, it is at fault and inconsistent in so far as involving the power of "rejection" by the Examiners.

As the allowance of a patent claim does not, by the act of the Bureau, establish the validity of a patented invention, by parity of reasoning the Bureau should not have the power of destroying a patent or forcing an appeal, and the payment of new fees. If the official rulings as to novelty and usefulness were made a part of the permanent record it would be the same thing as "rejection," in so far as official action, but would be looked upon in a very different light by applicants. If the action of an examiner was "advisory," and subject to reconsideration and substitution, its force would be just the same, and would shift the responsibility of issuing an invalid patent to the applicant, who must in any case stand the consequences of such issue, at the same time would place the examiner in a more important, dignified position.

It is true that such a method of procedure would conflict with the idea that a patent grant is an act of grace and not a "right," but this can well be afforded in the present view of the matter in this country, and under the laws that are now in force regulating such grants.

Our suggestion is that the records of procedure, including an abstract of all decisions of the examiners, as finally made, should be printed with the patent, and that it should be allowed to issue at any stage of procedure after the first action, at the choice of the applicant.

That the applicant should have the privilege of amendment as now, and also of appeal at moderate fees, so a patent could be taken from the Primary Examiner, from the Examiner in Chief, or from the Commissioner's ruling, as the applicant might elect, the decisions in each case being endorsed on the patent itself, and, as before said, forming a part of the final record in each case.

The methods of appeal under such a system might call for the institution of a new board of some kind instead of appeal to the Commissioner, because the amount of business under a second appeal would, no doubt, exceed the present facilities for dealing

with cases, but this could easily be provided for by a special board, consisting of the principal examiner and other officers that could act with the Commissioner in person.

The main suggestion is that the responsibility should in procedure, as it does in fact, rest upon the applicant, and that a patent when granted would bear upon its face evidence of the official action either confirming or questioning its novelty and consequent validity.

Under our present patent system there is a common opinion among applicants that the efforts of the Government are directed to preventing them from procuring patents. Such a view is of course a wrong one, but the fact remains, and the Patent Bureau instead of being regarded as a helping friend is viewed as a kind of ogre in the path of the inventor. This we say is a common impression, as any one familiar with the subject must admit.

The cause of this we venture to assert is almost wholly in the mandatory nature of the examiners' rulings. If such rulings were made advisory there would be a total change of opinion respecting procedure, while the functions of the office would in no way be impaired, and possibly rendered more useful. The danger of invalid patents certainly would not be increased, and the purchaser of a patent right would be much better protected than now when the action of the Patent Office is commonly a mystery.

Again stated, our view is that official action should be open and recorded, and that the applicant should become responsible by having the privilege at any time of asking and receiving his patent with the views of the Government's officers endorsed thereon; also that the applicant have the privilege of passing his patent through the various stages of appeal, no matter whether the actions were favorable or adverse. Under such a system the relation between the Patent Office and the Federal Courts would be much improved, and become in a sense coöperative, instead of as it is now, in many cases, emulative, not to say antagonistic.

CENTRIFUGAL PUMPS.

Now and then some one with mathematical skill resolves the quantities and conditions in centrifugal pumping, and brings out some wonderful results. The latest is the work of Mr. G. R. Bodman, of London, who clears up the whole matter as the two follow-

ing short extracts will show. Reverting to some long formulæ evolving quadratic equations, he says :

"This shows an increase in the flow of over 200 per cent. due to the alteration in the form of the vanes. In both cases the value of the coefficient has been taken as the same, but as a matter of fact it would be considerably greater for the 'Rankine' fan, even if the efficiencies were equal. This would tend to somewhat reduce the flow. Again, for a given speed and relative angle of inflow, there is only one radial velocity of flow at which the inflow occurs without shock ; so that if two fans of similar construction as regards the inlet are compared, having different velocities of flow, in one of them at least there must be loss by shock. * * * *

The conclusions so far arrived at may be summed up as follows : (1) The best form of vane may, for practical purposes, be taken as that which terminates radically at the outer circumference of the fan or pump disc, it being assumed that at the normal speed inflow takes place without shock. Vanes of the form in question as compared with vanes of the ordinary type give — (2) a higher efficiency for a given speed and diameter of fan ; (3) a greater lift under the same conditions ; (4) a greater delivery of water for a given head. (5) In order to secure these results it is desirable to make the vanes more numerous than when the latter are of the usual shape, in order to avoid too great a depth in proportion to radius of curvature."

If Mr. Bodmer's pumps perform under the same laws that seem to govern their action here, he would find that the form of vanes instead of producing such wonderful results would, if we disregard the friction of their tips, have about as much effect as the color of the paint on the outside of the pumps. In an encased wheel, for example, its function is to set in revolution the water it contains, or is passing through it, and this will be done as effectually with one form of vanes as another, and whether there be two or sixteen of them. The friction on the periphery being, as before said, the principal fact to be dealt with.

Supposing, however, that the form of the vanes was an element to be seriously considered in designing, such form would naturally follow the function of speed. The working velocity in average cases is $10\sqrt{\text{Head}}$, — in feet per second, so that under a head of 25 feet the velocity of the wheel would be 50 feet per second, or at least five times what the flow should be in the water around the wheel, so the tips of the vanes will drag at that rate over the water. Under a head of 100 feet, which is sometimes met with here, the velocity of the wheel would be about 100 feet per second, while the discharge flow or velocity around the wheel would be constant, as before said, from 8 to 12 feet per second. Now it is easy to see that for high heads

the vanes should be as narrow as possible at the tips and terminate tangentially.

Again, suppose the head to be two feet, as it is sometimes in draining operations here, and the ducts being short, the flow in the pipes is raised to 12 feet per second, then the velocity of the wheel and discharge water would be nearly the same, and the pump would operate by impact, or "mechanical push," so to call it, and the vanes should obviously be radial or curved forward. When an open wheel or fan is employed the conditions are much the same, but in neither case can the theoretical requirements be observed.

If, in these mathematical essays, there was given some information of practical value, such as data for the diameter of wheels or fans, the value of tangential energy at different heads, and the effect of changes in section or velocity of the current through the pump passages, or friction of the water and wheels, we could derive some benefit from them, but the shape of vanes can well be left to the opinions of makers.

In respect to the size or diameter of the wheels it is obvious that no useful result can be attained by moving the water through more than 360 degrees of rotation, and this would be a mathematical dimension for that member, but we imagine that the writer before named, assisted by most others who have had the matter in hand, cannot tell why such a rule is impracticable, or what the best dimensions are. The width of issue at the periphery is also a principal factor in resistance, but is commonly ignored, and the main thing of all, the wheel friction at high speeds, is not an element at all in such mathematical treatment as we have seen.

The experiments conducted some years ago by Professor Hesse, at the University of California, to determine the laws that govern the friction of symmetrical discs driven at high speed in water have never been given out, and probably were not conducted to a successful conclusion. These would have been of more use to makers of centrifugal pumping apparatus than all the literature that has appeared on the subject.

The throat or discharge, that formed the principal point in the Parsons' experiments, is another of those features that may be called an abstraction. One of the best makers here discards the diverting wedge or throat altogether at average heads, and its effect in any case is clearly a function of the velocity of flow, or, in other words, of the form and dimensions of the pump chamber in respect to the wheel, and so unimportant is this throat at high heads of 50 feet

or more, where the discharge flow is slow, that even the volute form of the pump chamber is of little or no value.

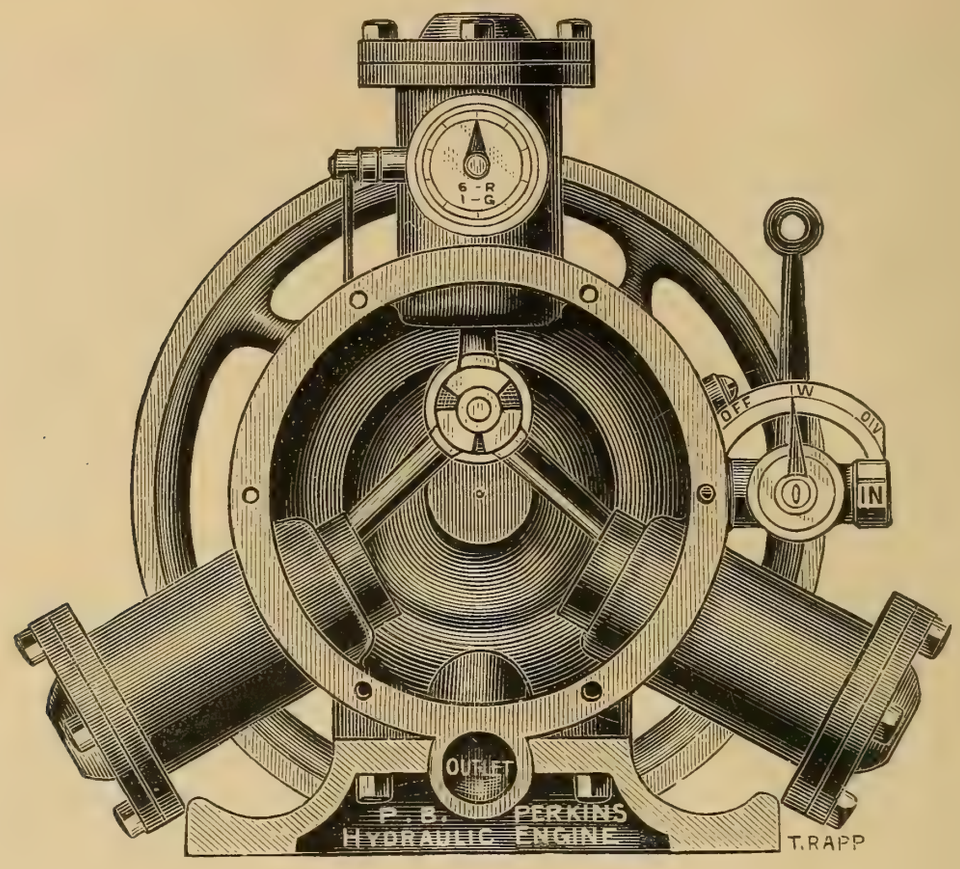
The best test for the various propositions respecting centrifugal pumping is in furnishing under a guaranty, machinery to raise a given quantity of water with a stipulated amount of power or fuel, as our engineers have to do on this Coast, and as various firms do in England and elsewhere. We have had here some application of the scientific methods of construction that have added greatly to drawings, machine patterns and expense accounts, but not to accomplished duty. The fault lies in the premises, not in the computations. The working conditions are too obscure for inference, and the literature of centrifugal pumping is yet to be written.

SCREW ENGINES OF THE GREAT EASTERN.

[See Frontispiece.]

We have engraved for a frontispiece this month a perspective drawing of the screw engines of the *Great Eastern*, engraved by the *Engineer*, London, about seven years ago when the mammoth vessel was moved by her own machinery from Milford Haven to Liverpool after lying idle for more than a dozen years. The chief interest in the drawing will be to indicate the great change that has come about in screw engines in a quarter of a century past, and also in the fact that these engines were made at the works of James Watt & Co., Soho, the shop of Boulton & Watt, which was a noted engine works at the beginning of this century, and long before.

The whole design is a straight symmetrical example of practice there, and a type only recently abandoned in war vessels, where the object was to place the machinery below the water for protection from shot. The rectangular section for various castings about the engines look queer to us now, but it must be remembered that the pressure of steam used at that time could be held by castings of any form. Any section thick enough to be run in casting would withstand 25 to 30 pounds per inch of pressure. The whole arrangement is extremely simple, and can be readily followed out by any steam engineer without explanation.



POSITIVE HYDRAULIC ENGINE.

PERKINS, BRANDT & CO., SAN FRANCISCO.

Positive water engines have been a fruitful source of invention, and their history one of interest and diversity. The Ramsbottom, three-cylinder oscillating type have held their place for thirty years or more, and are yet common. Other modifications of the multiple-piston type have appeared and disappeared, all, however, converging toward the design above, which seems to be the ultimate one, here carried out with the fewest parts, and in a very compact form. As the speed of these pressure engines is slow, three or more pistons are indispensable so as to maintain a constant turning strain on the shaft, and thus avoid heavy fly wheels that would otherwise be required.

In the design above the three pistons are all connected to one pin by a "Hicks" joint, a simple and ingenious expedient that has answered very well with single-acting pistons. Water distribution is performed by a valve at the back, the inlet and discharge pipes being marked indicates all that need be explained of the engines.

Messrs. Perkins, Brandt & Co., of this City, send us the engraving above, and furnish these engines for a variety of uses.

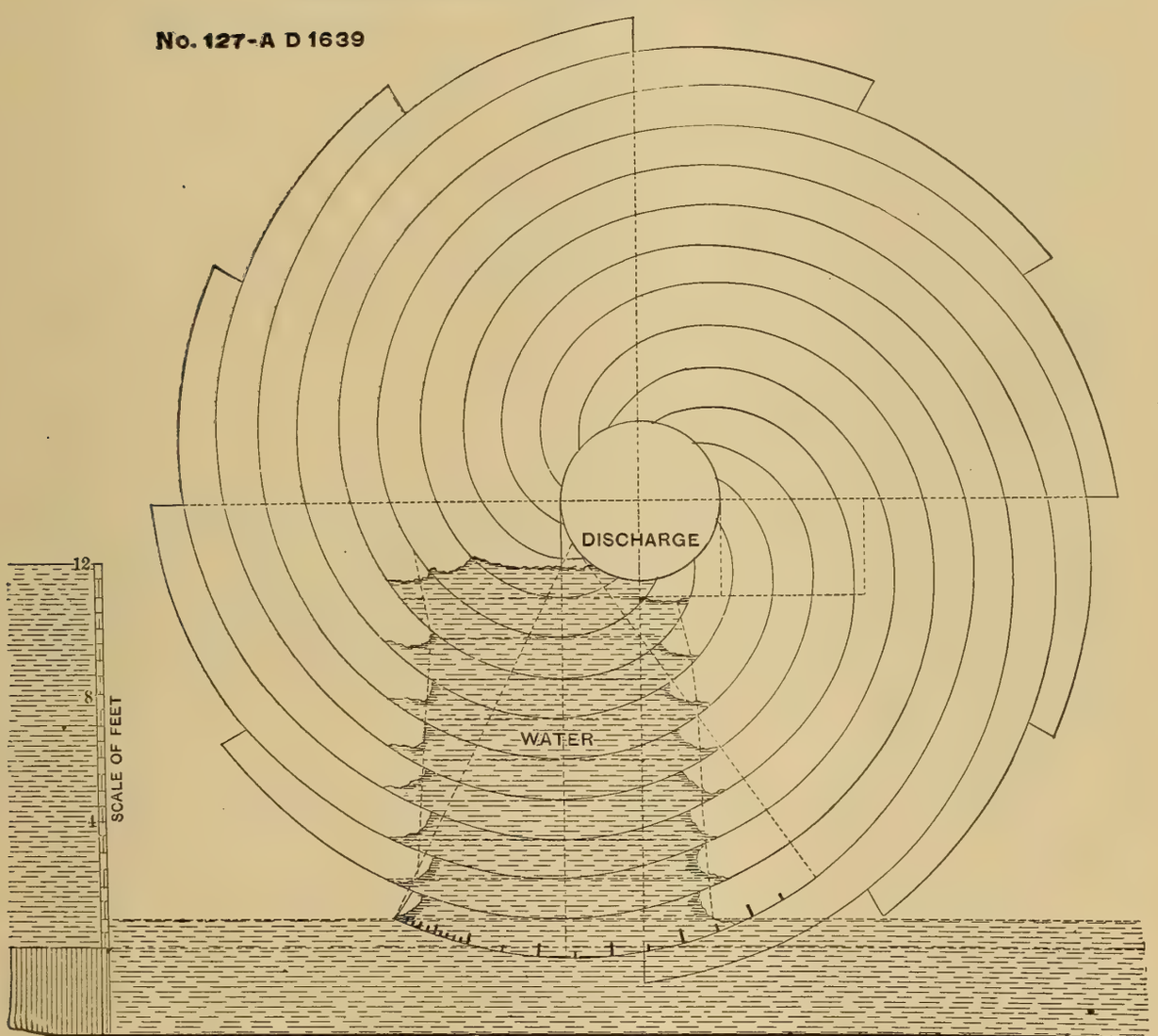
NOTES ON NEW AND PATENTED INVENTIONS.*

BY J. RICHARDS, IN CASSIER'S MAGAZINE

No. III.

British Patent, No. 127, June 24, 1642.

William Wheeler — Water Scoop Wheel.



The flexible title adopted for these articles permits the notice of patents of any date. The intention is, of course, to confine the subject mainly to new inventions, but for a divergence, and as a matter of some interest no doubt, the one above, now two hundred and fifty years old, has been selected for notice. It was granted

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150 years before the United States Patent Bureau was established, and is one of those quaint old productions containing essays, propositions, theorems, and arguments, also replies to specific objections, a Dutch patent communicated from the Netherlands soon after the Monopoly Act was abrogated in England.

It is a water-raising wheel, and was an improvement on the common water raising wheels, such as are yet extensively employed in Holland, the low counties in England, and also at New Orleans in this country, where there are several now in use to raise the city drainage so it will flow back to Lake Ponchartrain.

The inventor, like some at our day, did not lack either the confidence or courage to set forth his improvements. The water follows up the spiral compartments as the wheel revolves and runs out at the center. The inventor says the power required is as the distance of the water from the axis, and that:

"A water-scoop wheel in a water mill will raise water from 11 to 12 feet high with the same speed and working power, and with greater ease and in greater quantities, than three mills with the common water-raising wheels."

He winds up fourteen pages of description matter and argument with the following for the doubting:

"As for those who judge by slow understanding or careless reading, nothing can assist them. I did therefore care but little, or not at all, for the approval of such persons, merely endeavouring to demonstrate my proposition for intelligent readers, so as to deduct therefrom all circumstances relating thereto, allowing the working of the wheels (which in proper time shall give better proofs of themselves than I can) to instruct those who cannot be convinced by arguments."

We cannot refrain from printing the original Dutch patent on this wheel, dated June 18th, 1639, two hundred and fifty three years ago:

"The States General of the United Netherlands, to all whom it may concern, greeting.

Be it known that we have granted, and by these presents grant, to William Wheler, English Gentleman, for the next twelve years, the exclusive privilege of making, practicing, and working, and of allowing to be made, practiced, and worked, in these United Provinces and towns, several of his original Inventions that are worked: viz, of raising water in great quantities to a moderate height of from three to six, twelve feet and more. Also for raising mean quantities of water to great heights; great quantities being raised by hand, horse power, or wind; smaller quantities by hand, horse power, wind, water, or weights. We expressly forbid all

inhabitants of this country, within the prescribed term of the next twelve years, to make, or cause the said Inventions to be made entirely or partly, on a large or small scale, directly or indirectly, or to import counterfeits into the United Netherlands, for the purpose of selling or using them without the consent of the said William Wheler, under the penalty of forfeiting all counterfeits, and of a fine of five hundred Carolus gulden, to be disposed of as follows:—One third for the benefit of the officer who effects the seizure, one third for the poor, and the remaining third part for the benefit of the said William Wheler. Provided that it be a new invention, not made and worked by anyone else in this country, and provided also that he brings the same into full practice within one year from the present date, under the penalty of forfeiting the present Octroy, and without prejudice to all preceding general and particular grants. We, therefore, order and command all justices, officers, magistrates, and inhabitants of the said United Netherlands, and all those whom it may concern, to let the said William Wheeler enjoy and use our present Grant and Octroy to its full extent and without hindrance.

Given at the Assembly of the High States general, at the Hague, on the 18th June 1639."

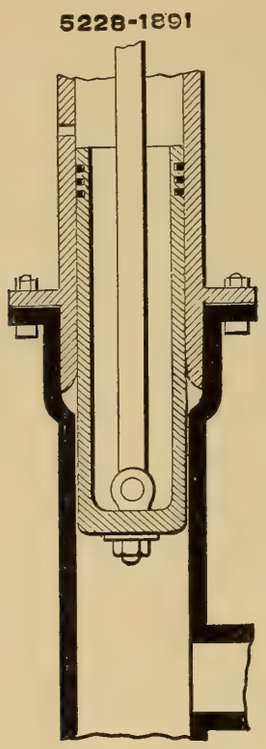
Cornelis Musch. (Signed) S. V. HAERSOLTE.

The British patent contains five double sheets of well executed drawings, only one diagram of which is reproduced here to show the nature of "Wheeler's wheel." One may well smile at the sanguine hopes that impelled this inventor to write a treatise and secure the action of the ponderous States General, without the trouble of making a wheel and seeing how much "wind" it would take to drive it, but there are people at this day, perhaps a good many, who will conclude, as Mr. Wheeler did, that this scoop wheel will somehow "coax" the water up without much power.

British Patent No. 5,228, 1891.

E. Stansfield.—Pumps.

The device shown in the diagram is one that has obvious merit. It consists in providing a pump with a close-fitting sleeve around the ram instead of the usual gland, the sleeve being made of non-corrosive metal bolted down firmly to the pump barrel and made long enough to cover the stroke. Packing rings are set in the ram to prevent leak past its sides, and as the liquid being pumped is not likely to find its way up around the plunger during a single stroke, it is very possible that with clean water a close joint can be maintained without the usual fibrous packing or cup-leather.



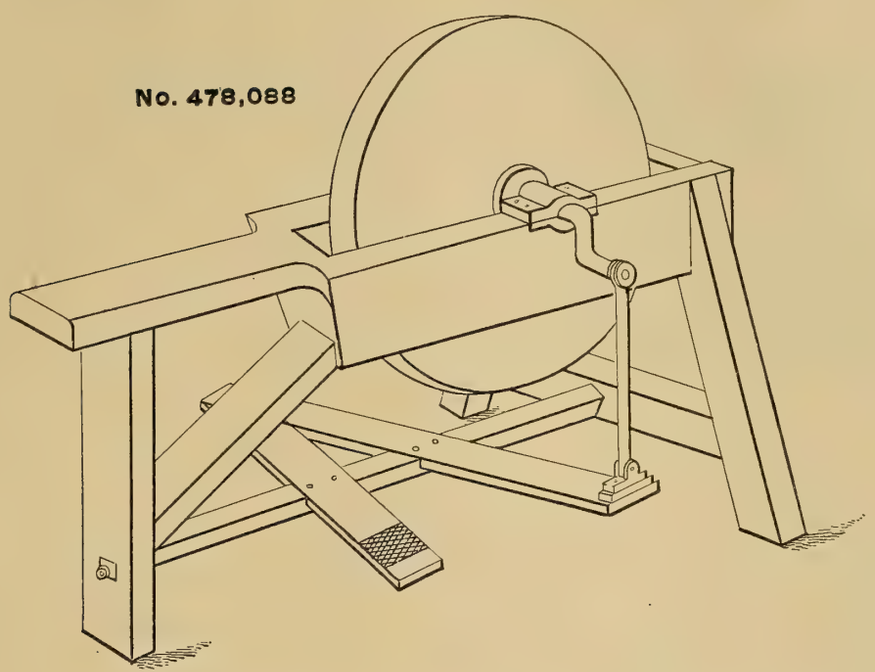
The long fit of the ram is considered a desirable feature. It prevents wear by reason of diagonal thrust, or other cause. These long fits around piston rods are doubtless a much better expedient than is commonly supposed, especially for steam. Prof. Sweet's Straight Line Engine is an example of the kind. The piston rods have no fibrous packing, but pass through a long sleeve or gland that seems to perform well without the elastic element. The sleeves employed by Professor Sweet are of soft metal and supposedly capable of compression, but in so far as we know are never compressed, keeping on for years even, without leaking.

The progress toward metallic packing, for steam at least, has been regular and progressive. A long bearing and some intercepting grooves that fill with water are the main features.

U. S. Patent No. 478,088, July 5, 1892.

G. Cochins.—Mechanical Motor.

This patent is graphically illustrated by a man sitting astride a grindstone bench, operating a treadle extending across the frame with a pedal on each side, as shown in the drawing. The "operator" has been omitted in our diagram taken from the patent. The contrivance is simple and cheap in so far as mechanism, but the



main purpose of introducing the device here is to illustrate and assist in some remarks on treadle power generally.

One would suppose that anything so old as a treadle would long ago have been evolved into some more convenient form, but with the exception of sewing machines that are operated by the muscles of the foot and ankle, without weight or without tramping, and the velocipede, which is a double treadle machine, we can refer to no example of treadle driving that is not bad.

The method employed for lathes, grindstones, and so on, is to stand on one foot and tramp with the other, which is awkward and objectionable. The supporting leg tires out directly, sooner even than the working one, and the operator's whole body, including arms and hands, is jerked about in a manner that prevents any accuracy or ease in what Sir Samuel Bentham calls "tool presentation." Anyone who for the first time attempts to use hand tools on a treadle lathe is defeated by this contortion of the body, and it is only by experience and habit that a chisel or other tool can be held in proper shape. It is tiresome and unnatural.

Mr. Cochins has here introduced the true elements, namely, a treadle for both feet, and a rest for the body and arms which are still, so as to permit free and exact use of the hands, but we think two separate treadles, "fore and aft," one at each side, would be better, also that in any operation requiring exactness of hand manipulation, "tramping" should be dispensed with. The treadles should be set forward and inclined, so the legs when straightened would be at

an angle of twenty degrees or so from vertical, so the main forces, instead of being from the weight of the body, would be exerted by straightening the legs. This would call for a saddle, or some kind of back support, and would not only be easier, but permit the application of a force in emergencies exceeding what the weight of the operator affords, and would leave the upper portion of the body in a state of rest or steadiness. This may hardly seem an engineering subject, but it is certainly a mechanical one, and relates to a class of contrivances that need reforming.

Shaft Couplings.

The patents on shaft couplings are so numerous and so diversified that it is thought the subject will have more interest if treated generally, hence reference to particular inventions will not be given in this case.

If one were to choose among the various mechanical devices in common use for one to illustrate the complexity and difficulty of perfecting even small details, no better subject could be chosen than couplings to connect together the ends of shafts.

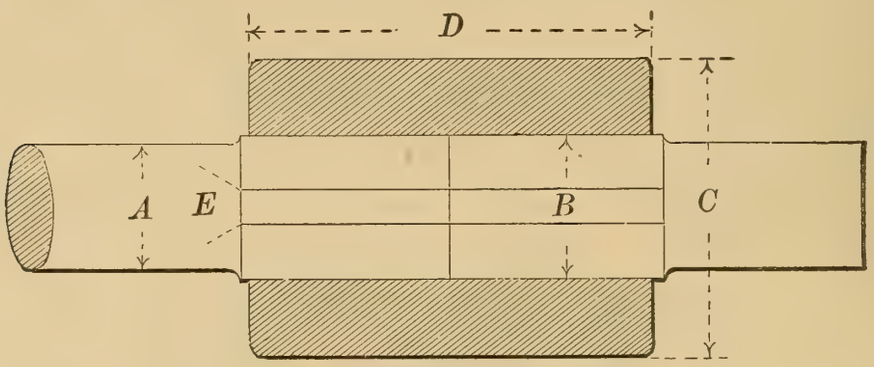


FIG. 1.

MUFF COUPLINGS.

Setting out originally, and proceeding by inference, the first thought would, no doubt, be of a plain sleeve into which the ends of the two shafts should be fitted, and as first thoughts are apt to be correct ones there would be no great mistake in this case, because the plain collars or sleeves, commonly called muff couplings, shown in Fig. 1 are, no doubt, the best ever invented, with limitations as to convenience and without limit as to cost.

These couplings are extensively employed in cotton mills in England and will continue to be, no doubt, not as many people suppose

because the engineers who build the mills do not know better, but for other reasons, some of which we will name.

In the first place the cost, which is excessive, is not to be considered much in a cotton mill so long as there is something gained in safety from accidents and from risk of detention. To stop a cotton mill, either for spinning or weaving, is a serious matter. The loss is not so much one of time, but by derangement of the processes. If weaving or spinning machines are stopped with the warp in, or when the frames are being drawn, there is derangement of everything, threads broken, cloth spoiled and general chaos. The rule is that a mill "must not stop," and one of the most frequent causes of accident is found to be in the shaft couplings. This fact is not confined to cotton mills, because the same cause of detention is common in all factories, and is, perhaps, the most common of all, where long lines of shafting are employed.

The muff coupling, made of wrought iron, bored with precision, and fastened by means of a long key extending the whole length and fitting into both shafts, gives absolute security in so far as driving. The truth of the work, and its endurance, is a matter of first cost and skill, and this, as before said, is not much considered in cotton-mill gearing. There is the advantage of a smooth symmetrical contour so that nothing will catch on the coupling. This is another important matter in a cotton mill where women and children work, and in a country where the injury of any one has to be compensated by heavy damages. In this respect muff couplings are absolutely safe, because perfectly smooth. The keys are fitted by scraping, driven in and out until a perfect bearing is secured the whole length, then the ends are cut of flush.

The ends of the shafts are enlarged, as the drawing shows. This too has its object, the shaft is not weakened by cutting the large key-ways required for the coupling, and there are no other key-ways required. The shafts, like the couplings, must be smooth, and key-ways of any kind are not permitted. Pulleys are made with their bore large enough to go over the enlarged ends of the shafts, and are fastened with conical bushes, or wedges rather, because the bush after being bored and turned true is slit up into six or eight parts for reasons that will be discussed further on. These keys are driven one at a time and equally, until the pulleys are so firmly fastened that they never come loose.

Here again is a reversion to first principles. This will be recognized as the old method of mounting wheels and pulleys on poly-

gonal shafts by keys or wedges driven at six, eight or more points around the shaft. With this much respecting the method of constructing muff couplings, and their objects, we will next consider their functions so as to compare them with other kinds of couplings to be hereafter considered.

It will be noticed that the same member, and with the same material, performs the double office of compression, or clamping, resisting torsion, and supplying continuous rigidity, or an increased rigidity, to the shafts through the coupled joint. This is one of the generic functions, so to call it, of well designed shaft couplings. Other functions are ample torsional strength of the coupling itself, and complete smoothness of the exterior, also the facility of easy removal to either shaft, but, in this case, not from the shafts altogether.

On the other hand we find a number of objections: First, and mainly, these couplings are not interchangeable, but must be specially fitted to a particular place, and are often fitted on short stubs to be welded to the shafts. Second, they cannot be removed or replaced without taking down the shaft. Thirdly, they are too expensive for an interchange system or for common use.

FLANGE COUPLINGS.

The next form to be noticed are flange couplings, such as are shown in end view and section, Figures 2 and 3.

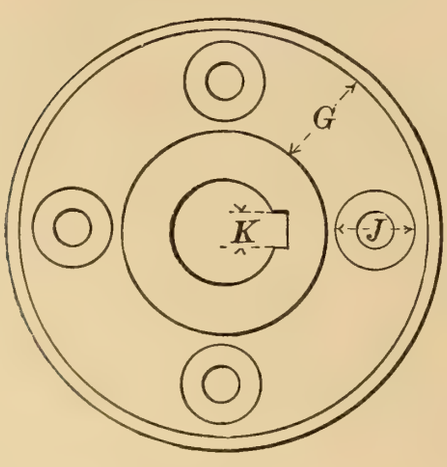


FIG. 2.

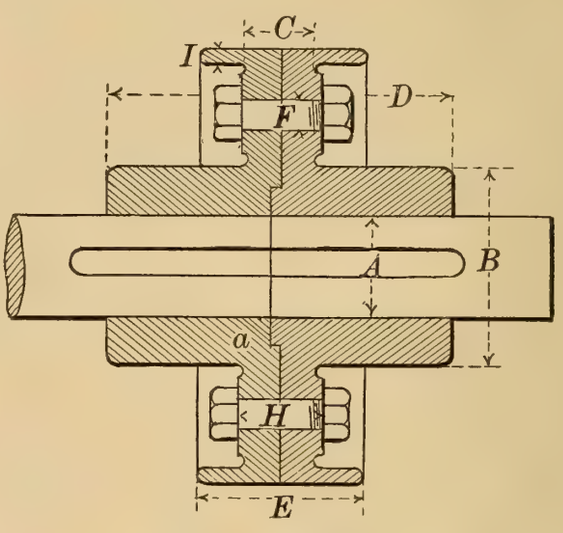


FIG. 3.

These are the most common, and are, in their nature, an integral part of the shafts to which they are fitted, consequently are not couplings except in the sense that they can be driven off and

replaced in the same place, and if well fitted will run true after being several times removed.

In order to stand severe strain they must be trial fitted, that is, driven on and off and the high spots filed or scraped down. This destroys the truth of the faces, and these have to be, or should be, trued off after the coupling is keyed on. If the work is true enough to drive on the couplings without fitting, their faces will be thrown out of truth by driving the keys, which usually bear both ways and especially on the back, or radially, so that facing off is necessary in all cases if the shafts are to run true.

They weaken shafts by reducing their section for key-ways, and cannot be removed without taking down the shafts, because the

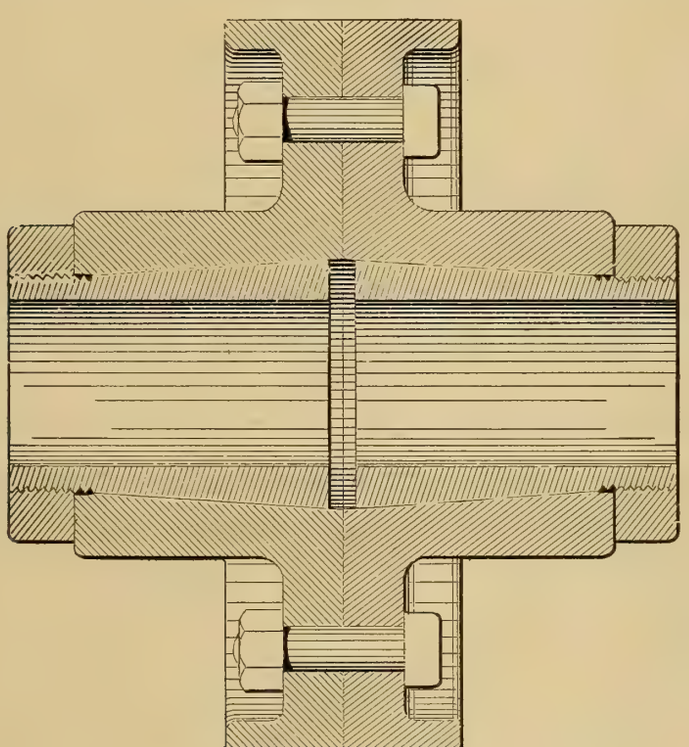


FIG. 4.

keys are driven from the inner faces. We need hardly say that such couplings or flanges to connect shafts are not interchangeable, but constitute special machinery, and cannot be employed for an organized manufacture of line shafting. They are commonly employed because easy to make, or easy to be made true by facing off, even if badly fitted, but mainly because so many kinds of interchangeable couplings are not strong enough, and cannot so well be made by common tools and appliances. Flange couplings do not belong in the organized manufacture of line shafting, consequently need not be farther considered here.

COMPOUND COUPLINGS.

Couplings of the flange kind have been made with bushes, as shown in Fig. 4, having conical shells in one or both ends. This would make the couplings interchangeable, in a sense, but the accuracy of fitting required would be the same or nearly the same as in the case of solid flanges with the taper bushes added, and we need hardly say too expensive for common use. If the bushes are applied to one flange only, and the other keyed on, the shafts have to be shipped with the fixed flanges on the ends, and this makes awkward and risky work. In one case we know of, a railway company refused to receive such shafts as freight.

(*To be continued.*)

AN EXPERIENCE WITH A 24-INCH GAS MAIN.*

By J. B. Crockett, San Francisco, Mem. Tech. Soc.

Usually, large engineering operations, such as any class of construction work, are attended with a certain amount of pleasurable anticipation, as the plans are being perfected, and a degree of pardonable pride as the final results are contemplated ; but once in a while we are confronted with engineering emergencies that require more skill and watchfulness for successful handling, yet are totally devoid of any of these compensations. This paper deals with one of the last.

What is now known as the Potrero Station of the San Francisco Gas Light Company, was built from 1869 to 1871. It is situated on the Bay Shore, and is bounded by Georgia, Humboldt, and Sierra Streets on the land sides.

The situation of the plant is favorable, with one exception, that the extreme southern part of the City is isolated from the large gas-consuming districts, by water-ways and marshes, extending westward far into the city. To provide an outlet for the gas made at these works, and avoid crossing Channel Creek, or the mud flats which mark the former boundaries of old Mission Bay, it became necessary to lay a twenty-four-inch cast iron main from the works to a point crossing Kentucky Street at Solano Street, thence over

*Read before the Technical Society of the Pacific Coast, March 3, 1893. Reprinted by permission.

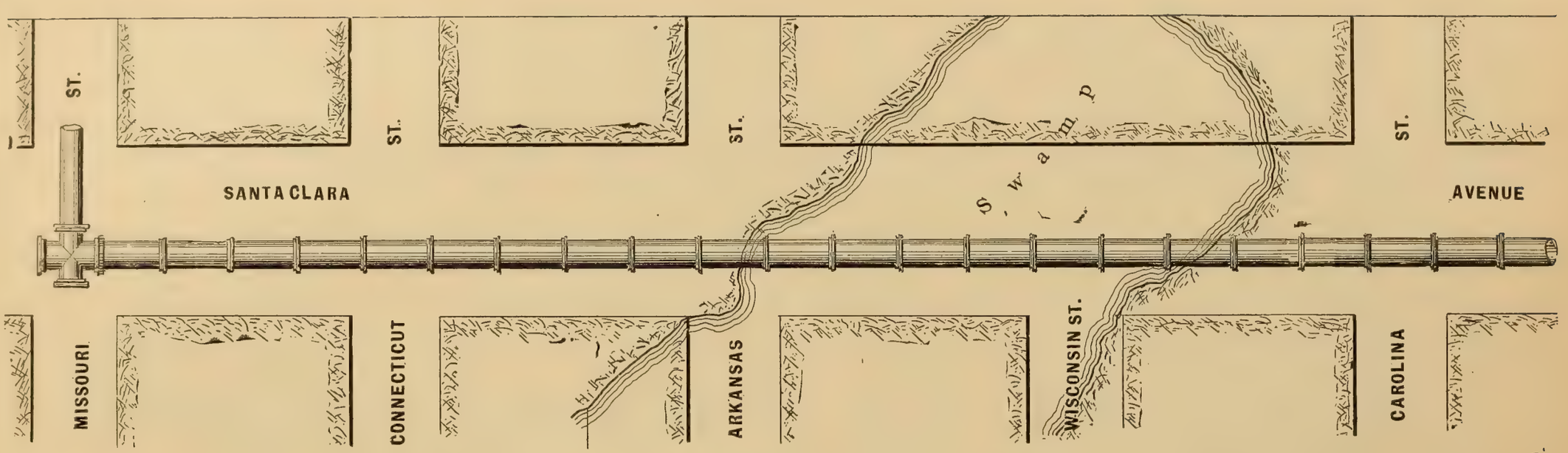
the high hills to the west to Mission Street, and thence in a northerly direction down the hill to the marsh at Santa Clara Avenue.

The pipe was laid beneath the surface of the marsh on Santa Clara Avenue, from Missouri to De Haro Streets, a distance of 1,424 feet, then in a northerly direction, 510 feet, to Center Street. From Center Street the large main enters the heart of the City through Ninth Street, and is there connected with the ramification of pipes which supply the city with gas.

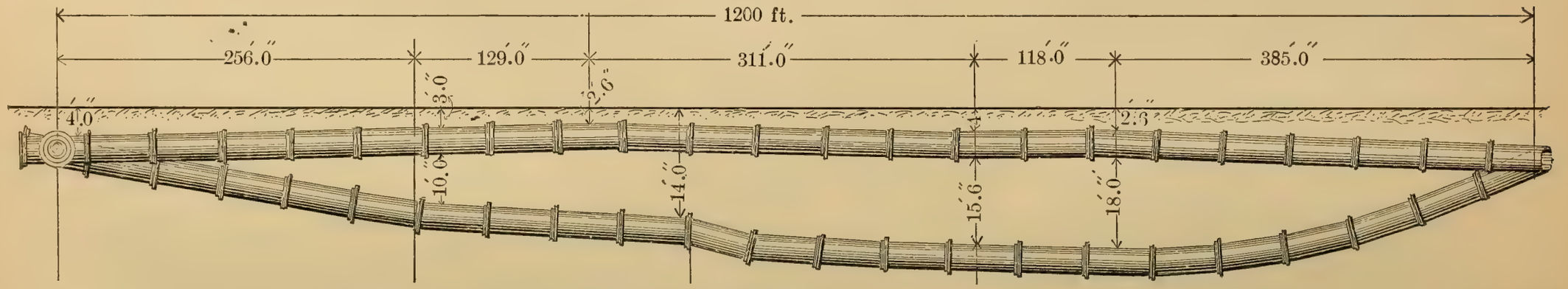
Where the pipe crosses the marsh on Santa Clara Avenue, it was laid with about three feet cover of earth, and to all appearances on as good foundation as many other gas mains in the City. At this place the ground was below the official grade, from two feet at the highest, to eighteen feet at the lowest points, but at the time the pipe was laid, no other nor more desirable location was available, nor could the ultimate grading of these streets be anticipated. On a sunny day, with the pipe snugly laid in the marsh, Santa Clara Avenue was like a peaceful valley, but after notice was served that the streets in the vicinity were to be graded, it proved to be a veritable "slough of despond." The first notice was the intention to grade Santa Clara Avenue from Missouri to Carolina Streets, and the intersecting streets. This covered four blocks or about twelve hundred feet of the twenty-four-inch main, and it became necessary to uncover and raise it before the filling was begun.

Before proceeding with a description of the raising of this large pipe, I want to lay stress upon the fact that this pipe was the main artery of the city's gas supply, which was constantly under pressure, and through which over three fourths of all the gas supplied by the San Francisco Gas Light Company was drawn. This was previous to the building of the new works at North Beach, and there was no substitute of any kind for it.

On December 16, 1890, work was commenced raising the pipe on Santa Clara Avenue, between Mission and Carolina Streets. It was necessary to raise the main without cutting or breaking it, and its success depended in a great measure on its flexibility due to lead joints. Had the joints been of cement, as they are almost uniformly made in Eastern cities, the rigidity of pipes and joints would, without doubt, have caused a break, or perhaps many serious breaks, but with about one hundred lead joints, 4¼ inches deep and half an inch thick, it became possible to raise the main without a fracture.



PLAN.



SECTION, SHOWING POSITION OF PIPE BEFORE AND AFTER RAISING.

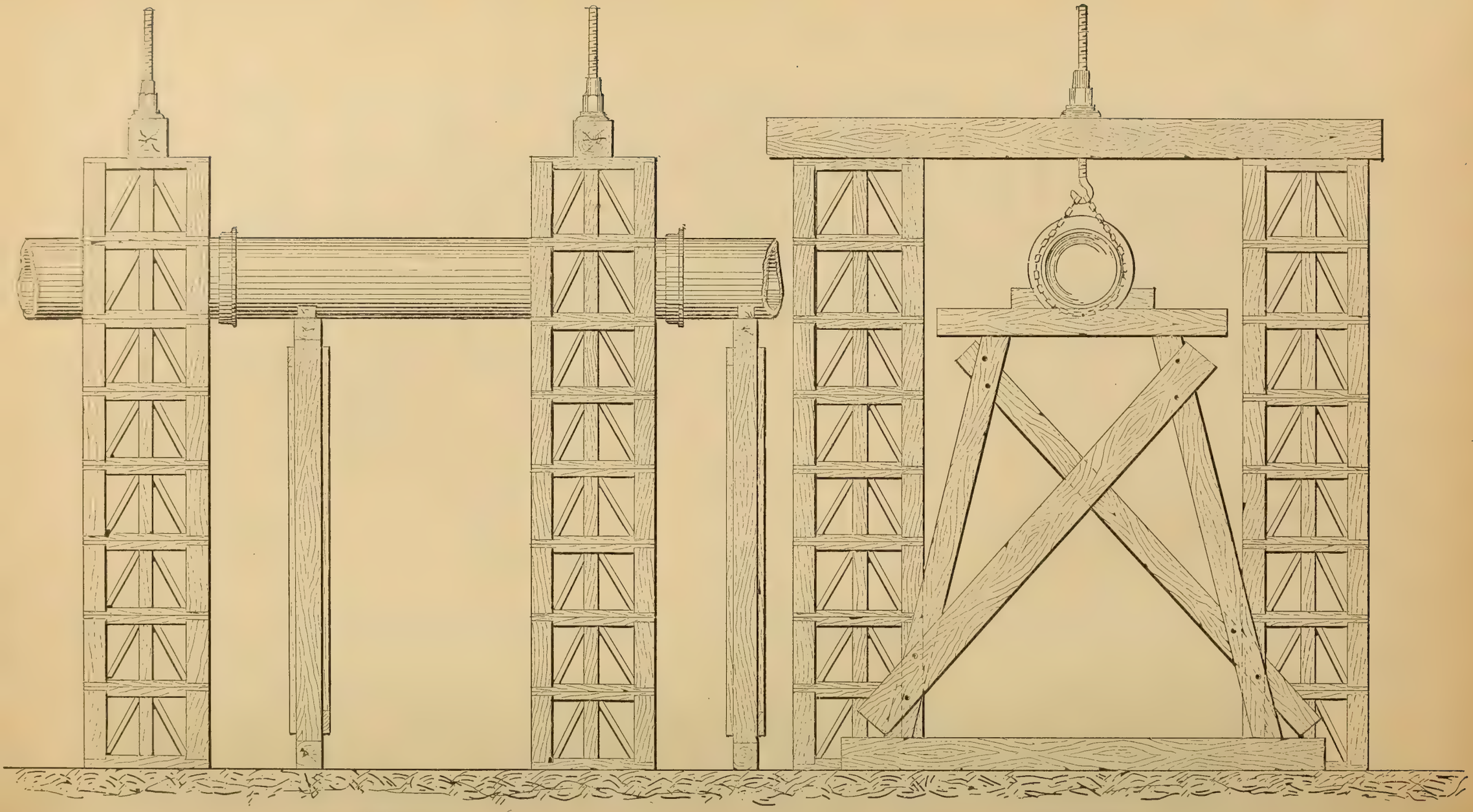
The first section to be raised, weighed about 260,000 pounds, and the method employed in raising it was as follows: The pipe was first uncovered, the trench extending to the bottom of the main, and at intervals of 12 feet of its entire length, house mover's frames were placed on each side, one above another, to the desired height. A 12 by 12-inch timber was placed across these tiers of frames, passing over the pipe just behind each joint. Heavy chains were passed around the pipe, back of each heel, and what is known as a two-inch "holder screw," was hooked to each chain and passed through a hole in the timber above. On the upper surface of the timber was an iron washer, and on this rested the large nut on the thread of the holder screw.

After taking up the slack on each chain, a man was detailed with a wrench to each screw, and at a signal from the foreman each man took one turn of the wrench, and the pipe was gradually raised. As the main was raised from the marsh, a gang of men was employed in blocking under it, to prevent its falling in case of the accidental breaking of any part of the lifting machinery, until finally, when it was raised to the desired height, or about three feet below the official grade of the street, the pipe was temporarily supported by house frames. Seven hundred and eighty of these frames, each 2½ feet high, were used in raising and supporting the pipe.

The next step was the permanent support of the pipe previous to the filling of the street. This was done by constructing a series of wooden trestles, five feet wide at the top and twelve feet wide at the bottom. They were made of 8 by 8-inch uprights with a sill underneath, and a cap at the top of the same dimensions, and braced diagonally by pieces 2 by 10-inch on each side. After the completion of the trestles, all the other supports, including the house frames used for raising, were removed, and apparently nothing remained to be done but to fill in the street with solid filling. The pipe had been raised without accident of any kind, all the joints had been re-caulked where they had drawn, and the permanent supports were amply strong.

The filling of the street was commenced immediately after the pipe was raised. This was done by taking the rock from the hills east and south of the fill, and transporting it in cars to the dump. This work was done by a contractor for the City.

As fast as the street was filled to grade, a gang of men kept the twenty-four-inch pipe uncovered, and all went well until the fill



Side View

End View

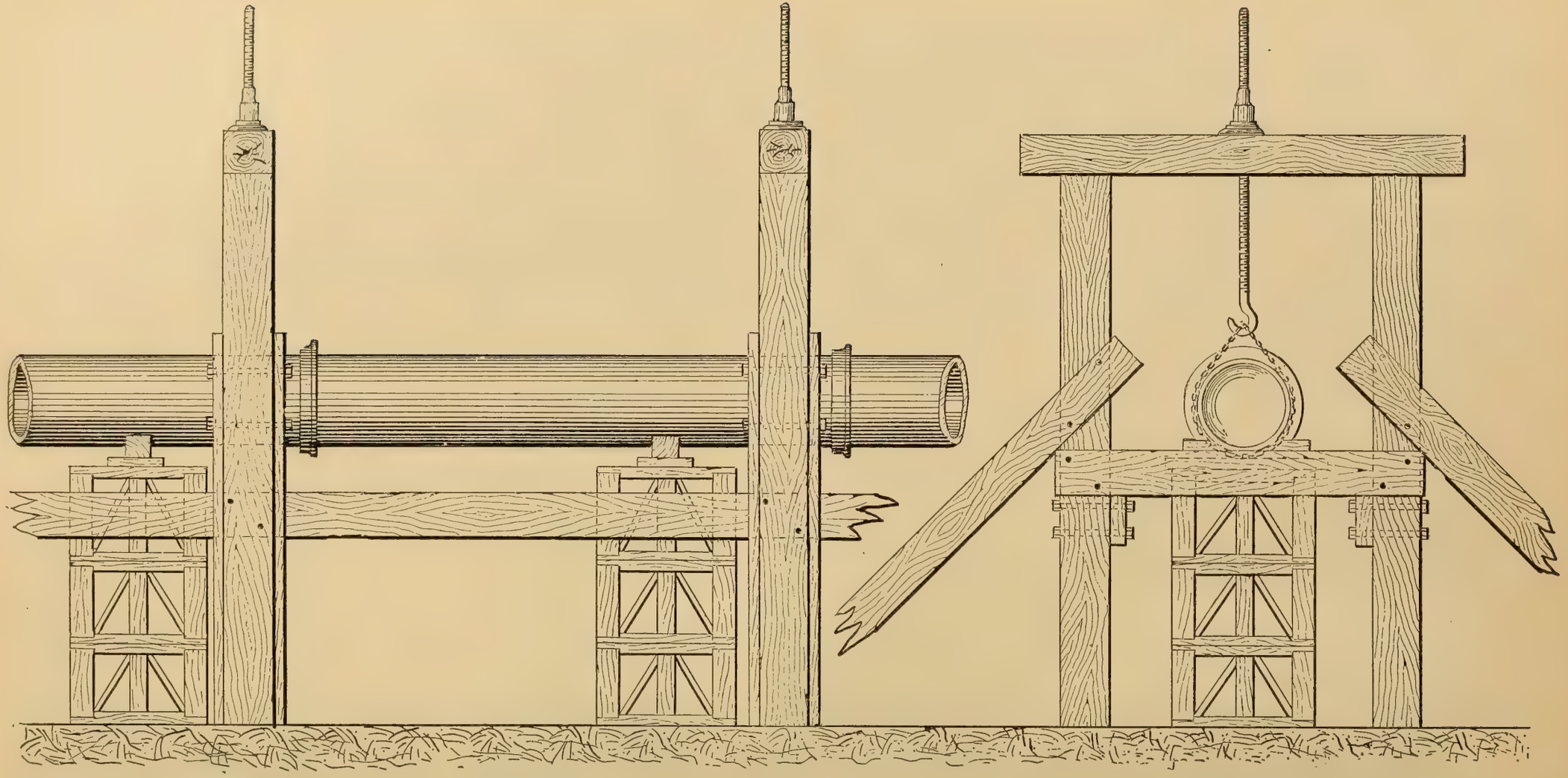
STRUCTURE SHOWING FIRST MANNER OF LIFTING AND SUPPORTING PIPE.

reached the corner of Santa Clara Avenue and Arkansas Street, when, on Saturday, April 11, 1891, at 11 o'clock P. M., the northerly side of the street began to slide toward the north, carrying the pipe and its supports with it. The main settled four feet and slid to the north three feet, and the wooden trestles were canted over in the direction of the slide.

A gang of men was immediately put to work shovelling the rock and earth away from the trestles to remove the pressure against them, and to distribute the material under the pipe. The following day a number of teams were employed to cart the material from the face of the dump, and to spread it along the line of the pipe, under and on each side of it. The object in thus carting the rock was to distribute evenly the load on the marsh, and gradually raise the whole street to the level of the pipe, instead of keeping up to the street grade, and presenting a steep face at the dump. Carting rock was continued until we had filled in solid under the pipe and had built a cartway about nine feet wide on each side of the pipe, level with the bottom of it. This required the handling of five thousand loads of stone. As the stone was hauled ahead and loaded on the marsh, the street continued to settle, carrying the pipe with it.

Four days after this first trouble, the crossing of Arkansas Street commenced to settle very rapidly, and in fifteen minutes the street had gone down four feet. The large body of rock settling in the mud, raised the surface of the marsh at a point about one hundred feet north of the street, about five feet high, and opened a crevice a foot wide. This was a natural consequence of the displacement of mud by the heavy fill of stone, but why over half of the filled street should slide bodily toward the north, at the same time, and where and when it would bring up? were perplexing questions. To ascertain the exact nature of the underlying strata of the marsh, and solve at least one of these problems, we caused soundings to be made in lines ninety-six feet long, extending from south to north, at right-angles to the pipe, by driving a half-inch iron bar into the ground. The crust of the marsh was found to be fairly firm to a depth of three feet, consisting of a sort of marl.

At the northerly side of the street, after passing through the crust, the bar sank into nineteen feet of soft mud, and then reached hard bottom. At the middle of the street the bar went down through seven feet of the same mud, while on the south side there were but two feet and six inches of the mud under the crust of the marsh. The stratum underlying this mud was an extremely hard clay.



Side View. End View.

STRUCTURE SHOWING SECOND MANNER OF LIFTING AND SUPPORTING PIPE.

These soundings explained to my satisfaction the cause of the body of rock sliding towards the north. The surface of the marsh was nearly level, but the thick body of soft alluvial mud was resting on a subterranean side hill of hard clay, sloping toward the north with a trend of fourteen degrees, and as the rock fill sank into the mud it slid, mud and all, down the slope of the hard bottom.

The soundings also explained the sudden and spasmodic settling of the fill. The three feet of firm crust over the marsh offered a resistance to the load of rock piled upon it, until the load was sufficient to overcome the resistance, when the crust broke, letting the entire fill settle from four to five feet at a time.

After the second settling of the pipe it was necessary to resort again to the house frames for raising it, as the wooden trestles had sunk into the marsh and were almost useless. After raising the pipe with screws to the proper height, jack screws were used for forcing it laterally towards the south, back into its proper line. By continuous wedging under the pipe, using in all about ten cart loads of wooden wedges, we arranged to keep the pipe in its place, until May 1st, when another settlement occurred, opening long fissures in the fill, and raising the surface of the marsh to the north about nine feet, and at the same time opening several long cracks nearly two feet wide. This was the most trying period of the whole undertaking, and as a safeguard I laid a line of twenty-inch pipe on the surface of the marsh, south of Santa Clara Avenue, and cut the twenty-four-inch pipe between Missouri and Arkansas Streets, and at Carolina Street, and put in **T**'s twenty-four by twenty.

This was done so that in the event of the destruction of the twenty-four-inch main, we could, by making short connections with the twenty-inch main, provide a way to deliver gas to the City temporarily. Fortunately, however, this new line was never used, but its presence was a source of relief.

The last serious settlement occurred on May 15, 1891, when 12 by 12-inch timbers, thirty feet long, were placed under each length of pipe, back of the joints, and the end of the timber towards the north was blocked up about two feet higher than the south end. With this precaution we were enabled to keep the pipe wedged up in place, although it was a constant source of worry and annoyance, until the rock fill had found a bottom on the hard clay and the street was brought to grade. At the crossing of Arkansas Street, which was the worst part of the marsh, the main was raised at the beginning sixteen feet, and the sum of all the settlement at that

point, was fourteen feet, that is, the entire fill settled into the marsh a distance of fourteen feet, so that it was necessary to raise the pipe in all, thirty feet, to maintain it at the sixteen-foot level.

The contractor continued filling in, until July 31, 1891, and the average amount of material dumped each day, from May 1st to July 31st, was twenty-three train loads of nine cars each, or about two hundred and seven cubic yards per day. As the contractor completed filling the street to grade, the pipe was kept uncovered, and a 12″× 12″ timber was placed across each length of pipe, resting on blocking and wedges, chains were passed around the pipe and holder screws were used for sustaining it. For months it was necessary to keep careful watch of the pipe, and men patrolled its entire length day and night, driving wedges and taking up the slack on the chains, wherever needed. In fact, during all this time Santa Clara Avenue became one of the Company's telephone stations, and for a while was the one most frequently used.

Finally, in November, 1891, the street had stopped settling, the timbers and screws were removed, and after carefully tamping the earth under the pipe, the trench was filled. Early in October, 1891, notice was received of the intention to grade Santa Clara Avenue west from Carolina Street, and as the twenty-four-inch main extended west as far as De Haro Street, (304 feet) it was necessary to raise it out of the marsh. At De Haro Street the pipe turns at a right-angle, and extends to Centre Street, (510 feet), and it was necessary to raise the entire 814 feet an average of about eight feet in height.

A pile structure was built to raise and sustain the pipe. Sixteen-inch piles, fifty feet long, were driven through the marsh into the hard clay bottom. These piles were spaced twelve feet apart, and were five feet from the pipe on each side. Ten feet outside of each standard pile a brace pile was driven and sawed off two feet from the ground. On each side of the standard piles, extending down to the brace piles, were diagonal braces 4″× 12″. Caps 12″× 12″ were placed over the main, resting on the top of the standard piles, and a screw passed through a hole in the middle of each cap. The pipe was raised as before described.

When the pipe reached the proper grade, waling pieces 4″× 12″ were bolted on the inside face of the standard piles, and across these were placed two planks 4″× 12″, on edge, resting on the waling pieces and bolted through the piles. The pipe rested on these 4″ × 12″ cross pieces, and was prevented from rolling by

pieces of 4″ × 4″. The entire wooden structure was securely bolted together.

The standard piles were for raising and permanently supporting the pipe, and the brace piles and the diagonal braces were to withstand any side thrust caused by sliding of the marsh.

One of the difficult features of this piece of work was the bracing of the right-angle in the main, at the corner of Santa Clara Avenue and De Haro Street. This was accomplished by driving ten piles around the **T** at the corner, and by a system of diagonal braces. To prevent the pipe from drawing apart, iron bands were bolted around it at the corner, and these bands were connected on each side by rods with turn-buckles.

After the pipe was raised and supported, the 12″ × 12″ caps were removed and the tops of the standard piles were sawed off below the grade of the street. As the street was filled, the pile structure stood the strain of the street settling, but there was little or no lateral thrust, as the clay under the marsh was nearly level at this point, and the fill did not slide.

This piece of work was not subject to any of the unfavorable conditions that so seriously affected the first part of the work. In fact, the method employed to raise the first section would have been successful in raising the second section; but it is doubtful if any wooden structure would have withstood successfully the various forces exerted to overthrow it, at the crossing of Santa Clara Avenue and Arkansas Street.

THE INVENTION OF CAST STEEL.

The following very interesting account of the original cast steel making, is taken from *Smile's Industrial Biography:*

"Benjamin Huntsman was born in Lincolnshire, in the year 1704. His parents were of German extraction, and had settled in this country only a few years previous to his birth. The boy being of an ingenious turn, was bred to a mechanical calling; and becoming celebrated for his expertness in repairing clocks, he eventually set up in business as a clock maker and mender, in the town of Doncaster. He also undertook various other kinds of metal work, such as the making and repairing of locks, smoke-jacks, roasting-jacks, and other articles requiring mechanical skill. He was remarkably shrewd, observant, thoughtful, and practical; so much so that he came to be regarded as the 'wise man' of his neighborhood, and

was not only consulted as to the repairs of machinery, but also of the human frame. He practiced surgery with dexterity, though after an empirical fashion, and was held in especial esteem as an occulist. His success was such that his advice was sought in many surgical diseases, and he was always ready to give it, but declined receiving any payment in return.

In the exercise of his mechanical calling, he introduced several improved tools, but was much hindered by the inferior quality of the metal supplied to him, which was common German steel. He also experienced considerable difficulty in finding a material suitable for the springs and pendulums of his clocks. These circumstances induced him to turn his attention to the making of a better kind of steel than was then procurable, for the purposes of his trade. His first experiments were conducted at Doncaster, but as fuel was difficult to be had at that place, he determined for greater convenience, to remove to the neighborhood of Sheffield, which he did in 1740. He first settled at Handsworth, a few miles to the south of that town, and there pursued his investigations in secret. Unfortunately no records have been preserved of the methods which he adopted in overcoming the difficulties he had necessarily to encounter. That they must have been great, is certain, for the process of manufacturing cast-steel of a first-rate quality, even at this day, is of a most elaborate and delicate character, requiring to be carefully watched in its various stages. He had not only to discover the fuel and flux suitable for his purpose, but to build such a furnace and make such a crucible as should sustain a heat more intense than any then known in metallurgy. Ingot-moulds had not yet been cast, nor were there hoops and wedges made that would hold them together, nor, in short, were any of those materials at his disposal, which are now so familiar at every melting furnace.

Huntsman's experiments extended over many years before the desired result was achieved. Long after his death the memorials of the numerous failures through which he toilsomely worked his way to success, were brought to light in the shape of many hundredweights of steel found buried in the earth in different places about his manufactory. From the number of these wrecks of early experiments, it is clear that he worked continuously upon his grand idea of purifying the raw steel then in use, by melting it with fluxes at an intense heat in closed earthen crucibles. The buried masses were found in various stages of failure, arising from imperfect melting, breaking of crucibles, and bad fluxes, and had been hid away as so much spoiled steel, of which nothing could be made. At last his perseverance was rewarded, and his invention perfected; and though a hundred years have passed since Huntsman's discovery, the description of fuel (coke) which he first applied for the purpose of melting the steel, and the crucibles and furnaces which he used, are for the most part, similar to those in use at the present day. Although the making of cast-steel is conducted with greater economy and dexterity, owing to increased experience, it is question-

able whether any maker has since been able to surpass the quality of Huntsman's manufacture.

The process of making cast-steel, as invented by Benjamin Huntsman, may be thus summarily described. The melting is conducted in clay pots or crucibles manufactured for the purpose, capable of holding about 34 pounds each. Ten or twelve of such crucibles are placed in a melting furnace similar to that used by brass founders; and when the furnace and pots are at a white heat, to which they are raised by a coke fire, they are charged with bar steel reduced to a certain degree of hardness and broken into pieces of about a pound each. When the pots are all thus charged with steel, lids are placed over them, the furnace is filled with coke, and the cover put down. Under the intense heat to which the metal is exposed, it undergoes an apparent ebullition. When the furnace requires feeding, the workmen take the opportunity of lifting the lid of each crucible and judging how far the process has advanced. After about three hours' exposure to the heat, the metal is ready for "teeming." The completion of the melting process is known by the subsidence of all ebullition, and by the clear surface of the melted metal, which is of a dazzling brilliancy like the sun when looked at with the naked eye on a clear day. The pots are then lifted out of their place and the liquid steel is poured into ingots of the shape and size required. The pots are replaced, filled again, and the process is repeated; the red-hot pots thus serving for three successive charges, after which they are rejected as useless.

When Huntsman had perfected his invention it would naturally occur to him that the new metal might be employed for other purposes besides clock-springs and pendulums. The business of clock-making was then of a very limited character, and it could scarcely have been worth his while to pursue so extensive and costly a series of experiments merely to supply the requirements of that trade. It is more probable that at an early stage of his investigations he shrewdly foresaw the extensive uses to which cast-steel might be applied in the manufacture of tools and cutlery of a superior kind; and we accordingly find him early endeavoring to persuade the manufacturers of Sheffield to employ it in the manufacture of knives and razors. But the cutlers obstinately refused to work a material so much harder than that which they had been accustomed to use; and for a time he gave up all hopes of creating a demand in that quarter. Foiled in his endeavors to sell his steel at home, Huntsman turned his attention to foreign markets, and he soon found that he could readily sell abroad all that he could make. The merit of employing cast-steel for general purposes belongs to the French, always so quick to appreciate the advantages of any new discovery, and for a time the whole of the cast-steel that Huntsman could manufacture was exported to France.

When he had fairly established his business with that country, the Sheffield cutlers became alarmed at the reputation which cast-steel was acquiring abroad: and when they heard of the preference

displayed by English as well as French consumers for the cutlery manufactured of that metal, they readily apprehended the serious consequences that must necessarily result to their own trade if cast-steel came into general use. They then appointed a deputation to wait upon Sir George Saville, one of the members for the county of York, and requested him to use his influence with the government to obtain an order to prohibit the exportation of cast-steel. But on learning from the deputation that the Sheffield manufacturers themselves would not make use of the new steel, he positively declined to comply with their request. It was indeed fortunate for the interests of the town that the object of the deputation was defeated,, for at that time Mr. Huntsman had very pressing and favorable offers from some spirited manufacturers in Birmingham to remove his furnaces to that place; and it is extremely probable that had the business of cast-steel making become established there, one of the most important and lucrative branches of its trade would have been lost to the town of Sheffield.

The Sheffield makers were therefore under the necessity of using the cast-steel if they would retain their trade in cutlery against France; and Huntsman's home trade rapidly increased. And then began the efforts of the Sheffield men to wrest his secret from him. For Huntsman had not taken out any patent for his invention, his only protection being in preserving his process as much a mystery as possible. All the workmen employed by him were pledged to inviolable secrecy; strangers were carefully excluded from the works; and the whole of the steel made was melted during the night. There were many speculations abroad as to Huntsman's process. It was generally believed that his secret consisted in the flux which he employed to make the metal melt more readily; and it leaked out amongst the workmen that he used broken bottles for the purpose. Some of the manufacturers, who by prying and bribing got an inkling of the process, followed Huntsman implicitly in this respect, and they would not allow their own workmen to flux the pots lest they also should obtain possession of the secret. But it turned out eventually that no such flux was necessary, and the practice has long since been discontinued. A Frenchman named Jars, frequently quoted by Le Play in his account of the manufacture of steel at Yorkshire, paid a visit to Sheffield towards the end of last century, and described the process so far as he was permitted to examine it. According to his statement all kinds of fragments of broken steel were used; but this was corrected by Le Play, who states that only the best bar steel, manufactured of Dannemora iron, was employed. Jars adds that 'the steel is put into a crucible with a flux, the composition of which is kept secret,' and he states that the time then occupied in the conversion was five hours.

It is said that the person who first succeeded in copying Huntsman's process was an ironfounder named Walker, who carried on his business at Greenside near Sheffield, and it was certainly there

that the making of cast-steel was next begun. Walker adopted the ruse of disguising himself as a tramp, and feigning great distress and abject poverty, he appeared shivering at the door of Huntsman's foundry late one night when the workmen were about to begin their labors at steel casting, and asked for admission to warm himself by the furnace fire. The workmen's hearts were moved and they permitted him to enter. We have the above facts from the descendants of the Huntsman family, but we add the traditional story preserved in the neighborhood, as given in a well-known book on metallurgy—

'One cold winter's night, while the snow was falling in heavy flakes, and the manufactory threw its red glare of light over the neighborhood, a person of the most abject appearance presented himself at the entrance, praying for permission to share the warmth and shelter which it afforded. The humane workmen found the appeal irresistible, and the apparent beggar was permitted to take up his quarters in a warm corner of the building. A careful scrutiny would have discovered little real sleep in the apparent drowsiness which seemed to overtake the stranger, for he eagerly watched every movement of the workmen while they went through the operations of the newly discovered process. He observed first of all, that bars of blistered steel were broken into small pieces, two or three inches in length and placed in crucibles of fire clay. When nearly full a little green glass broken into small fragments was spread over the top and the whole covered over with a closely-fitting cover. The crucibles were then placed in a furnace previously prepared for them, and after a lapse of from three to four hours, during which the crucibles were examined from time to time to see that the metal was thoroughly melted and incorporated, the workmen proceeded to lift the crucible from its place on the furnace, by means of tongs, and its molten contents blazing, sparkling and spurting were poured into a mould of cast-iron previously prepared; here it was suffered to cool, while the crucibles were again filled and the process repeated. When cool, the mold was unscrewed aud a bar of cast-steel presented itself, which only required the aid of the hammerman to form a finished bar of cast-steel. How the unauthorized spectator of these operations effected his escape without detection tradition does not say; but it tells us that before many months had passed, the Huntsman manufactory was not the only one where cast-steel was produced.'

However the facts may be, the discovery of the elder Huntsman proved of the greatest advantage to Sheffield; for there is scarcely a civilized country where Sheffield steel is not largely used, either in its most highly finished forms of cutlery, or as the raw material for some home manufacture. In the mean time the demand for Huntsman's steel steadily increased, and in 1770, for the purpose of obtaining greater scope for his operations, he removed to a large new manufactory which he erected at Attercliffe, a little to the north of Sheffield, more conveniently situated for business purposes.

There he continued to flourish for six years more, making steel and practicing benevolence; for, like the Darbys and Reynoldses of Coalbrookdale, he was a worthy and highly respected member of the Society of Friends. He was well versed in the science of his day, and skilled in chemistry, which doubtless proved of great advantage to him in pursuing his experiments in metallurgy.

That he was possessed of great perseverance will be obvious from the difficulties he encountered and overcame in perfecting his valuable invention. He was, however, like many persons of strong original character, eccentric in his habits and reserved in his manner. The Royal Society wished to enroll him as a member in acknowledgment of the high merit of his discovery of cast-steel, as well as because of his skill in practical chemistry; but as this would have drawn him in some measure from his seclusion, and was also, as he imagined, opposed to the principles of the society to which he belonged, he declined the honor. Mr. Huntsman died in 1776, in his seventy-second year, and was buried in the churchyard at Attercliffe, where a gravestone with an inscription marks his resting place.

His son continued to carry on the business, and largely extended its operations. The Huntsman mark became known throughout the civilized world. Le Play, the French Professor of Metallurgy, in his *Memoire* of 1846, still speaks of the cast-steel bearing the mark of "Huntsman and Marshall" as the best that is made, and he adds, 'the buyer of this article who pays a higher price for it than for other sorts, is not acting merely in the blind spirit of routine, but pays a logical and well deserved homage to all the material and moral qualities of which the true Huntsman mark has been the guarantee for a century.'"

FORCED DRAUGHT FOR FURNACES.

We mention in another place some conclusions of Mr. Stut, of this City, respecting forced draught, pointing to different conditions of combustion when the furnaces are working under compression, and if it now turns out that the "intensity" of fires is not the economic feature at all, it will serve to show how little after all we know of combustion. The following facts, reprinted from *The Engineer*, London, shows some remarkable results from "compressed" draught, which we think is a better name for the system.

"We believe that the following statements will be found to possess interest for many of our readers. They refer to ships fitted with the Howden system.

Two years ago Messrs. Denny & Co. built two steamers for the British India Steam Navigation Company, the *Vadala* and *Virawa*.

These steamers were alike in every particular in hull and machinery with the exception of the boilers, the *Vadala* having two double-ended natural draught boilers with eight furnaces 3 feet 7 inches internal diameter, while the *Virawa* had two single-ended boilers with Howden's forced draught, having four furnaces 3 feet 6 inches internal diameter. These two steamers have been working in the Eastern Seas for the last two years, and have been carefully tried by the company in order to ascertain the difference in consumption and otherwise. They have taken every precaution to arrive at a correct comparison by changing the engineers from the one ship to the other, etc., to eliminate any chance of error from better management in one ship than the other. The report they now send, which we have through Messrs. Denny & Co., is that besides the other advantages of forced draught the *Virawa* performs the same work as the *Vadala* on 15 per cent. less fuel. The coal used is to a large extent Bengal coal. This comparison, it will be noticed, is giving the natural draught every advantage in large boiler power, as the *Vadala* has eight 3 feet 7 inch furnaces against the *Virawa's* four 3 feet 6 inches. In addition to the saving in fuel, the *Virawa* has also shown the maintenance of a considerably higher average speed. Probably in no case has there been so much care taken to arrive at a fair comparison as in these trials, so they may be accepted as in every way correct, and in no way prejudiced by personal interests.

The Steamship *Alene* and Steamship *Adirondack* are two steamers belonging to Messrs. Leach, Harrison and Forwood, and fitted with triple expansion engines and boilers for 160 pounds pressure; the *Adirondack* with natural draught, and the *Alene* with Howden's forced draught. The results are as under. The coal used is American, and the indicated horse power is the average over each voyage on the revolutions taken by counter from day to day.

Ship.	Distance Knots.	Time H. M.	Average Speed.	Coal Tons.	Dispt. Tons.	I. H. P.
Adirondack out	1469	135 36	10.85	148	4097	1382
Alene "	1476	132 55	11.1	138	——	1682
Adirondack home	1469	121 18	12.1	133.6	3160	1496
Alene "	1467	121 51	12.	126	——	1725

It will be observed that the *Alene* with forced draught is more than twenty per cent. better than the *Adirondack*.

In the report, sent by Mr. A. B. Forwood, of a voyage to the West Indies with the *Alene*, he mentions that he considered the forced draught was indispensable for their trade, as they could maintain a steady speed of twelve knots with ease under all conditions of atmosphere, and that instead of the men sweltering in the stokeholds in sultry weather trying to maintain steam, as in natural draught steamers, the stokehold was the coolest part of the ship. He noticed also that there was not a particle of dust or soot on the deck of the ship, a condition of things the very opposite from what he had been led to expect from the use of forced draught."

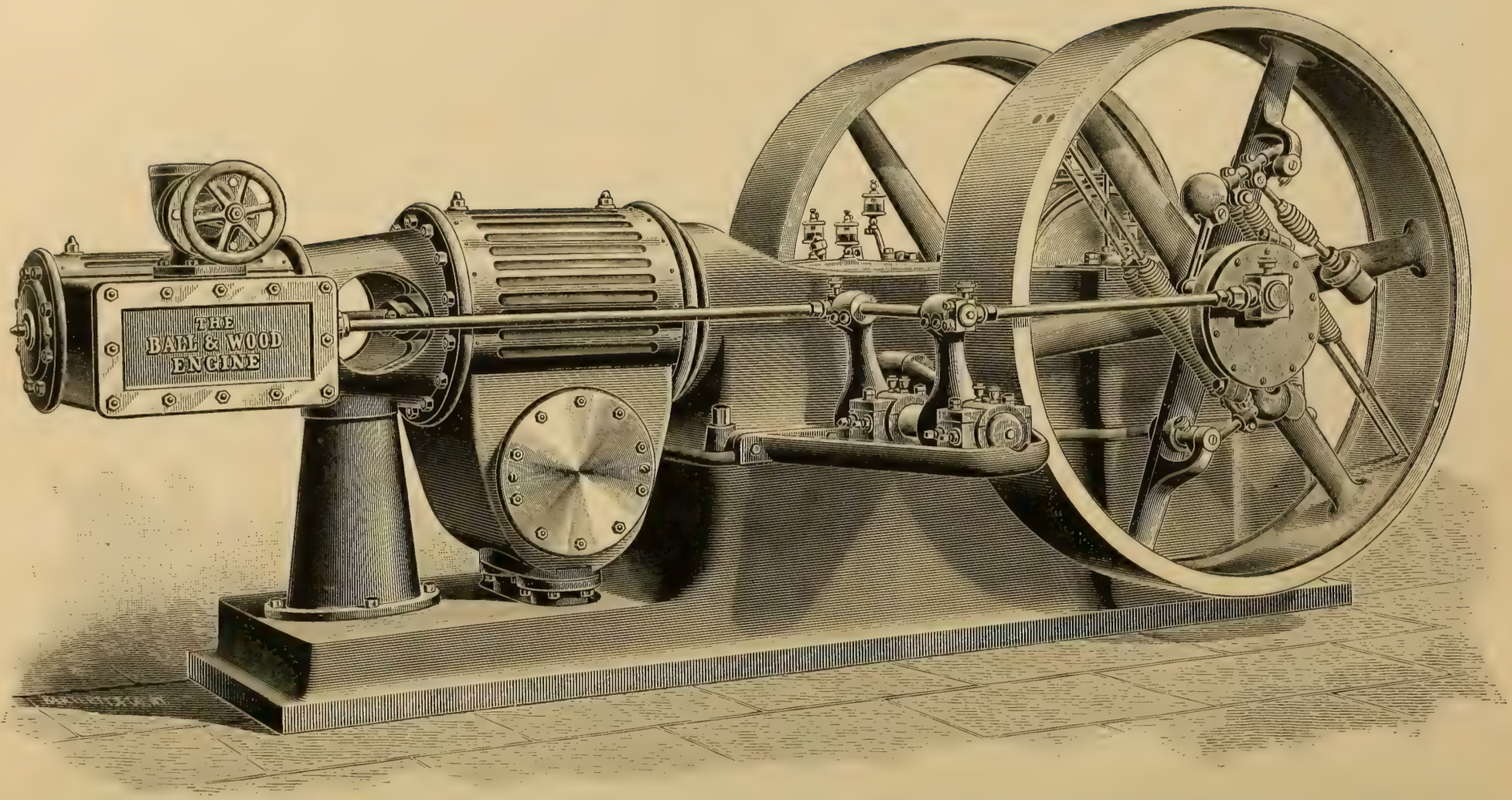


FIG. 1. COMPOUND HIGH-SPEED TANDEM STEAM ENGINE.—THE BALL & WOOD ENGINE CO., NEW YORK.

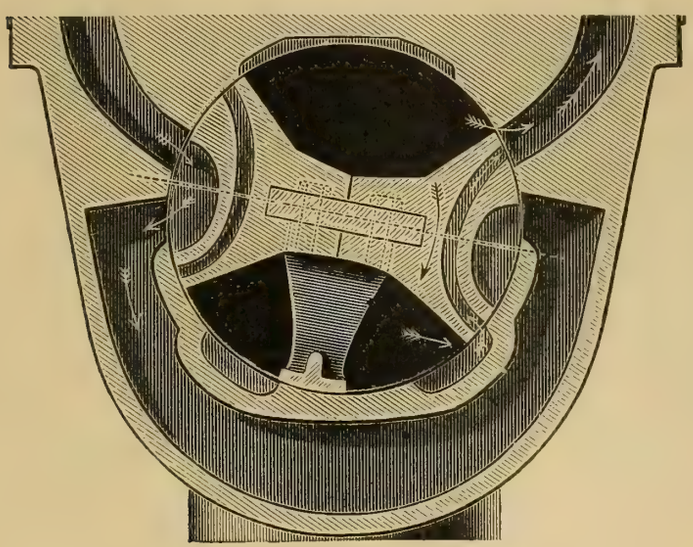


FIG. 2.

HIGH-SPEED COMPOUND STEAM ENGINE.

THE BALL & WOOD ENGINE CO., NEW YORK.

The plate on the opposite page represents an advanced type of modern high-speed steam engines having a number of points of novelty in design and construction. The evolution of engines of this class, besides calling out various problems in thermo dynamics, has forced a higher standard of construction in both fitting and material, and marks an epoch in steam engineering much wider than is commonly supposed. The race has been in so many hands, and the development so diffused, so to speak, that its true importance is not appreciated. Something is added here and there, the whole practice however converging toward a discernible standard for most, if not all, parts of high-speed engines.

In the present engine, so well illustrated in the drawing as to not require general description, there are a number of special features of a novel kind. The wheels are fastened by splitting the bosses on one side and providing clamping screws. In addition to this there are two keys set diagonally with their corners on a radial line, which with respect to strains as well as all other conditions of use seems to be a much better method than to set the faces tangentially.

The principal features of the engine, aside from general design, are in the valves, which for the initial cylinder have opposing faces in a vertical plane, and are balanced by steam pressure. The valves for the low-pressure cylinder, shown in section in Fig. 2, are quite novel. They are double ported, of the oscillating type, and afford, no doubt, the most direct flow of steam both into and out of

the cylinder that it is possible to attain. The arrows indicate the admission and exhaust flow at the beginning of a stroke. The large diameter or span of the valve causes a corresponding rapidity of movement, and, as may be seen, without limit as to port area.

The governor to operate the high-pressure or cut-off valve is so arranged that the variable elements are confined to "indication," only the resistances of movement falling on mechanism rigid for the time, and independent of the centrifugal strain.

The makers can be congratulated on a distribution of metal and contour of framing that shows a careful "working out" of the whole design without involving any ornate appendages.

STRENGTH OF THE TEETH OF GEAR WHEELS.

We recently sent to Mr. F. Orton, of this City, a table showing the horse power that can be transmitted by cast-iron tooth gearing, or in other words the strength of teeth, asking him to correct some errors in the quantities. In return we received the following communication, which explains itself, and is thought will be of interest to our readers. The following formula was enclosed with our note, and is the one referred to in the communication:

$$H = P^2 \, V \, B$$

In which H = horse power; P the pitch; V velocity in feet per second, and .06 a constant for cast iron.

To the Editor of Industry:

Sir:—The formula you send is wrong, so also the table, in assuming that the power transmitted by wheel teeth is as the square of the pitch. The table has the additional fault of the values assumed being far too small.

The force transmitted by teeth per inch of breadth or face is directly as the pitch. The force a tooth will transmit when its breadth is two and one half times the pitch is as the square of the pitch, and this has, no doubt, led to the common rule for the breadth of teeth, and to the error in the table referred to.

The permissible strain on cast-iron teeth, under different conditions of use, ranges all the way from 200 to 750 pounds for teeth of 1-inch pitch and 1-inch face. My idea of a correct table would be to base it upon the ultimate static strain the teeth will bear, and then qualify this by varying factors to suit the conditions of use.

A writer in the *American Machinist*, some years ago, made this classification, which I think is good:

"Class 1. Slow speeds; power equally applied being the greatest loads the machinery should be subjected to under the most favorable conditions. Factor of safety, 5.

Class 2. Moderate speeds; power freely communicated, but without the intervention of fly wheels or similar accumulations of energy. Factor of safety, 6.

Class 3. Strains suddenly applied with considerable shock such as is in shears, punches and ordinary mill gearing. Factor of safety, 8.

Class 4. Strains suddenly reversed in direction with severe shock. Factor of safety, 10."

The factors of safety given refer to a formula for computing strength that accompanied the article, and only go with it, because no two persons figure the strength on the same premises, nor get the same results. He places the value of teeth far above what common text books allow, and is right in that, but in my judgment goes a little beyond good safe practice of the present time.

For teeth of 1-inch pitch and 1-inch face I think the allowable force to be transmitted, where shafts are strongly supported, in line and kept in line, as in iron-frame machines and machines mounted on continuous bed plates bolted to foundations, may be taken as follows, referring to the classification above given.

Class 1, 750 pounds; Class 2, 500 pounds; Class 3, 300 pounds; Class 4, 200 pounds.

Rules pertaining to the strength of wheel teeth seem vague, and not applicable under the varying conditions of practice. It is true a rule that will cover extreme cases would be safe for all, but this is neither good practice nor necessary, because the difference between a train of wheels that have to be reversed, or are subject to violent shocks, is a very different matter from a train that performs a constant amount of work under regular or nearly regular strain. Both of these extreme conditions exist in practice, demanding a difference in strength at least as three to one, and between these lie the various conditions of use which should be provided for in designing such gearing.

In respect to the quality of the iron employed for wheels, I need not say that it varies greatly, but any provision for this would not only involve a second variable factor in any rule; even then would have to rest upon judgment in each case.

A rule I have to propose for the strength of cast-iron teeth has been deduced from such data as exists, from my own experience and observation, qualified so far as possible by the condition of miscellaneous practice on this Coast. It is as follows:

$$H = \frac{P\,F\,V}{33} \times K$$

P representing the pitch in inches; F the face or width of the teeth; V the velocity in feet per second; H the horse power transmitted; K a coefficient variable as follows:

For gearing running at low speed, and transmitting a uniform force — $K = 0.75$.

For gearing running at ordinary speed, not subject to shock, such as caused by irregular or sudden resistance to the momentum of fly-wheels or other heavy moving parts — $K = 0.5$.

For gearing on prime movers, and all gearing subjected to heavy shock, such as caused by irregular or sudden resistance to the momentum of fly wheels or other heavy moving parts — $K = 0.3$.

For gearing subjected to violent shock, such as caused by sudden reversing under heavy strain — $K = 0.2$."

The following table for horse power transmitted has been computed by the above formula, omitting the coefficient K. The numbers given in the body of the table are to be multiplied by its various values as the conditions of use may demand, and as before noticed.

POWER TRANSMITTED BY CAST-IRON GEAR WHEELS PER INCH OF FACE.

Pitch in Inches.	VELOCITY IN FEET PER MINUTE.										
	15	30	60	120	240	360	480	600	720	960	1200
½	.2272	.4545	.9090	1.818	3.636	5.454	7.272	9.090	10.90	14.54	18.18
¾	.3409	.6818	1.363	2.727	5.454	8.181	10.90	13.63	16.36	21.81	27.27
1	.4545	.9090	1.818	3.636	7.272	10.90	14.54	18.18	21.81	29.09	36.36
1¼	.5681	1.136	2.272	4.545	9.090	13.63	18.18	22.72	27.27	36.36	45.45
1½	.6818	1.363	2.727	5.454	10.90	16.36	21.81	27.27	32.72	43.63	54.54
1¾	.7954	1.590	3.181	6.363	12.72	19.09	25.45	31.81	38.18	50.90	63.63
2	.9090	1.818	3.636	7.272	14.54	21.81	29.09	36.36	43.63	58.18	72.72
2½	1.136	2.272	4.545	9.090	18.18	27.27	36.36	45.45	54.54	72.72	90.90
3	1.363	2.727	5.454	10.90	21.81	32.72	43.63	54.54	65.45	87.27	109.0
4	1.818	3.636	7.272	14.54	29.09	43.63	58.18	72.72	87.27	116.3	145.4
5	2.272	4.545	9.090	18.18	36.36	54.54	72.72	90.90	109.0	145.4	181.8
6	2.727	5.454	10.90	21.81	43.63	65.45	87.27	109.0	130.9	174.5	218.1

The values above recommended contemplate that wheels are mounted on rigid shafts, firmly supported and parallel, also that pinions having teeth of less thickness at the roots than .45 of the pitch, be well shrouded, or made of stronger material than cast iron.

F. ORTON.

San Francisco, February, 1893.

A CAUSE OF BOILER EXPLOSIONS.

[Communicated.]

To the Editor of Industry:

Sir:—Destructive boiler explosions continue to destroy life and property, and will not cease to do so, so long as safety is sought for in escape valves and strong boilers. There are other causes to be considered. Strong boilers with properly adjusted safety valves explode, and the stronger the boiler the greater the havoc wrought. Low water alarms do not furnish security, and I respectfully submit the proposition, as has been done many times before, that the phenomena of destructive boiler explosion are not to be accounted for by the expansive force of steam alone. They require some other explanation than the expansive force of steam. This has been many times admitted, and various theories have been advanced as to some kind of chemical reaction that evolved explosive gases.

To these I will add another one in respect to incrustation, and desire to point out that a coating of carbonate of lime, for example, interposed between the water and iron, furnishes a possible cause of explosion if such scale or crust is broken by distortion of the plates or other cause, that rupture the scale and permit the water to come in contact with the iron heated far above the limit imposed by water contact.

With a non-conductor, such as scale, between the iron and water, the iron will be overheated where greatest heat impinges, here the iron will change its shape sufficiently to dislodge the scale, and permit the iron to be approached by moisture, which under such conditions will not prevent further "burning" of the iron, and instead of steam, hydrogen gas will be generated, which will re-unite with the oxygen.

The strength of a boiler may be determined with a reasonable degree of accuracy, and its pressure controlled and directed by appliances of no great strength. Excessive pressure in a boiler is prevented by providing a weak point, a safety valve which will yield at a certain pressure, and allow steam to escape as fast as generated. This is all simple enough, but does not account for explosions.

The action of dynamite is the most familiar parlalel to the effects produced by a boiler explosion. The pressure and speed of expansion are so excessive they can only be vaguely surmised by results, and the generation of the pressure so instantaneous as to be entirely beyond the control of appliances which would be effective with steam alone.

In a late issue at hand of a well-known mechanical paper, published in New York, appears the statement that "with occasional exceptions it is very generally held now that boilers explode when they are too weak for the pressure within them, or, as an engineer

once said, when there was 'more steam inside them than there was room for.'"

The effects of over pressure of steam would be to cause leaks at weak points. If pressure continued to increase, the boiler would burst at the weakest part to an extent sufficient to relieve the pressure; but between such bursting and a boiler explosion there is as much difference as between the bursting of a pipe from pressure of cold water, and one from an explosion of powder, and it is certain that boiler explosions will continue while the practice exists of having combustion take place in contact with iron having water backing. Red-hot copper does not decompose water. The generation of hydrogen gas would be prevented by substituting copper for iron in contact with the fire, but at a sacrifice of fuel unless the furnace was arranged for slower combustion.

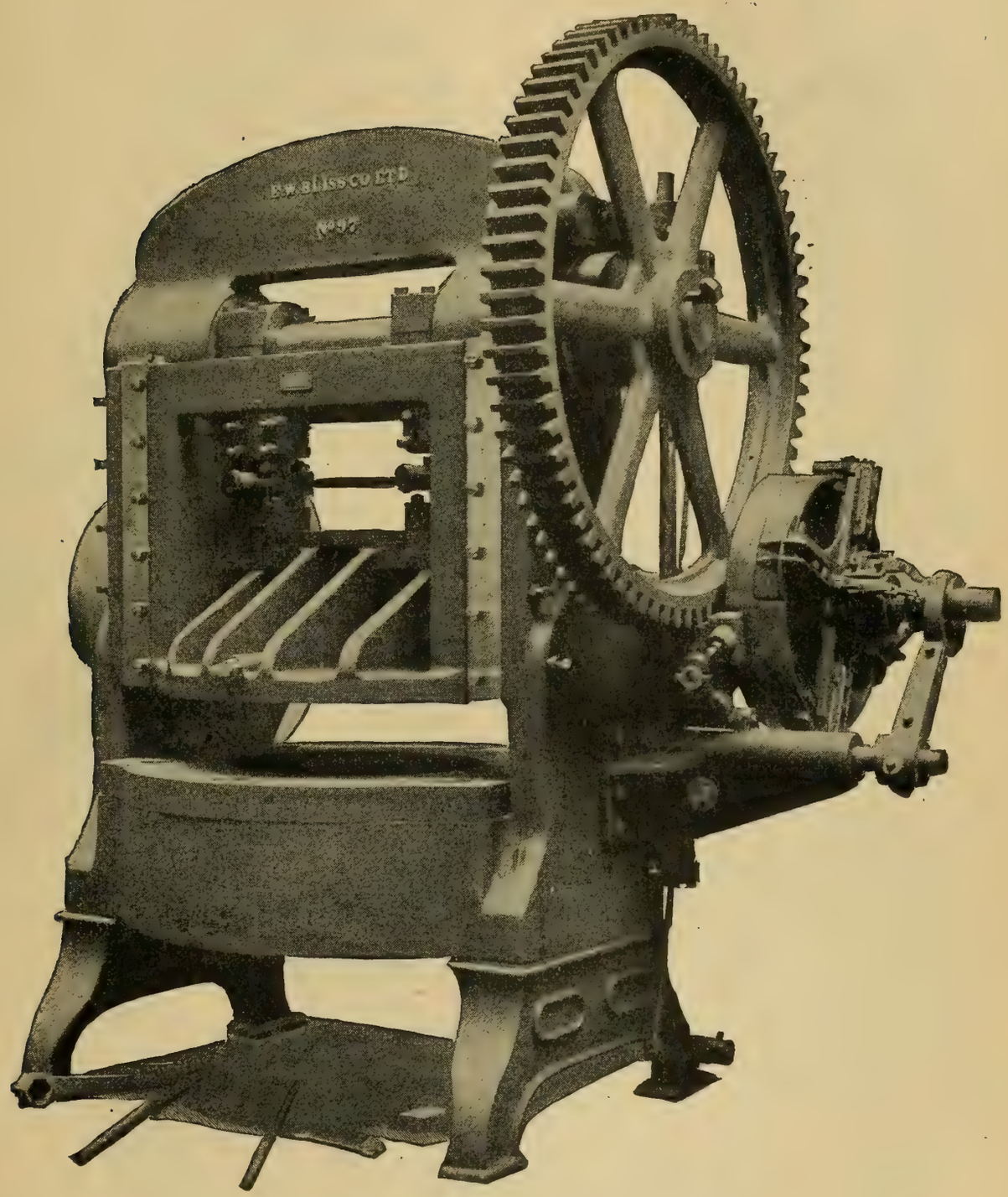
Alameda, Cal., Jan. 1893. JAMES L. HENDERSON.

JUDGES AT THE COLUMBIAN EXHIBITION.

Messrs. John Boyd Thatcher, of Albany, New York; William J. Sewell, of New Jersey; A. T. Britton, of the District of Columbia and A. B. Andrews, of North Carolina, have been appointed an Executive Committee of the World's Exhibition at Chicago to select judges to report on the merits of exhibits and determine awards. This committee have their headquarters at Albany, New York. The following extract from a circular issued will explain the objects of the committee:

"The management of this whole matter is in the hands of this Executive Committee on Awards, which is receiving applications for appointments as judges at their temporary offices and address as above. After March 15th the office will be permanently established in the Administration Building of the World's Columbian Exposition, at Jackson Park, Chicago. As the judges are to be so far as possible competent experts, and the duties of the position require efficiency and ability of a very high order, and it is the desire of the Executive Committee to appoint only those absolutely qualified for the place, and, whenever possible, of national and international reputation, this Executive Committee considers it its duty to call the attention of the technical journals of the country to the facts in order that it may receive the assistance and co-operation of those who by their position and connections are best able to assist the committee."

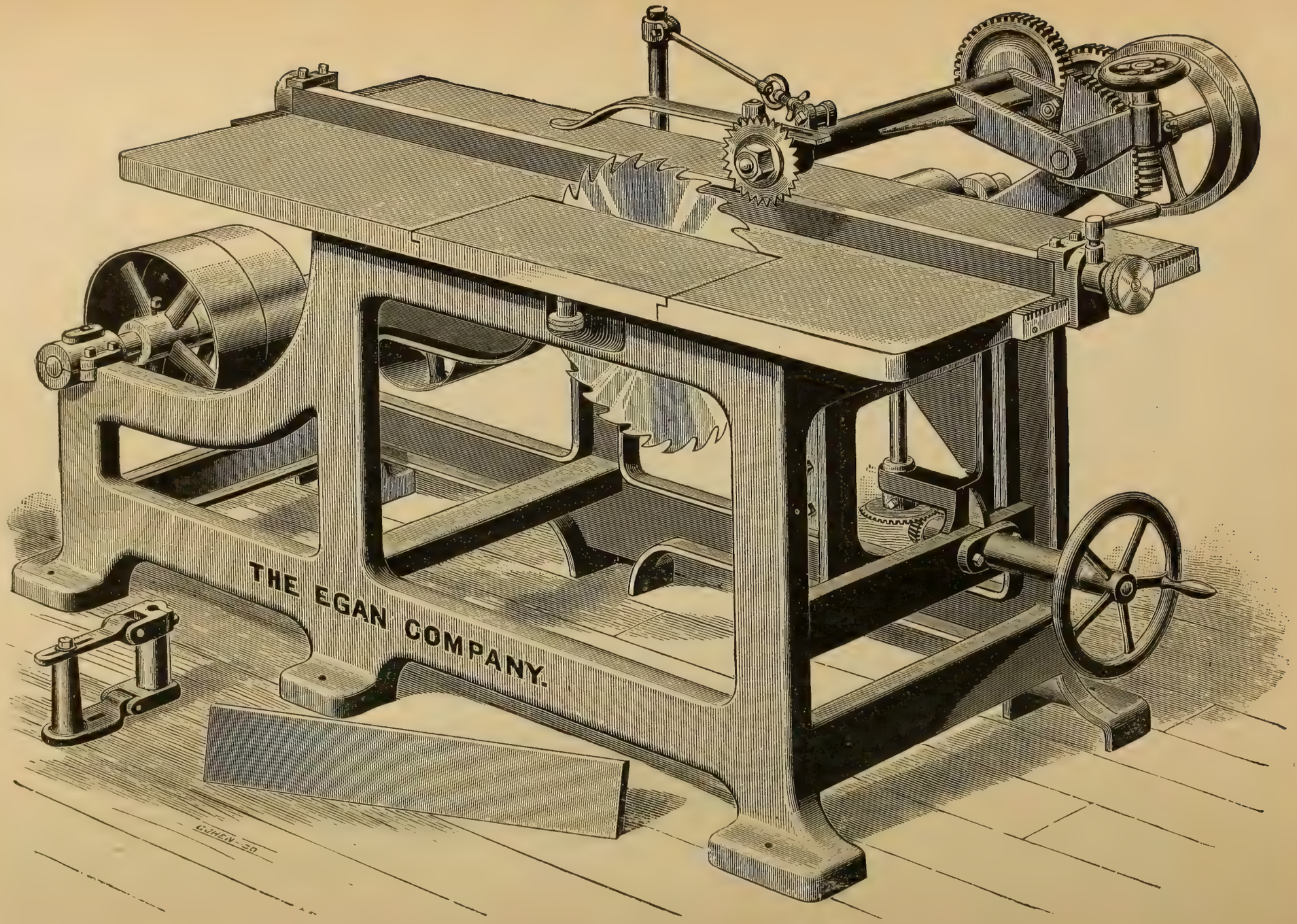
There will be a petition to Congress asking an appropriation to compensate the judges selected at the rate of $600 each for American members, and $1,000 for foreign members. The service will require about two months' time, beginning June 1st.



NEW METAL PUNCHING PRESS.

E. W. BLISS CO., BROOKLYN, N. Y.

We, some time ago, illustrated and commented upon a press by the E. W. Bliss Company, arranged with frictional engaging gearing, and prophesied that the old positive clutch devices would be abandoned for friction apparatus for all machines having rapid motion at least. This seems to have been done by the company



Power–Feeding Saw Bench.—The Egan Co., Cincinnati, Ohio.

named, and is one feature of the machine shown above. The friction clutch on the right is operated by a treadle, and is disengaged automatically at each revolution of the main shaft, and its driving wheel. At the same time a brake is applied to the wheel, arresting the movement almost instantly.

The main point in the present machine to which we wish to call attention is the method of mounting the main head in which the discs are fixed. This, it may be seen, spans the whole frame and is guided at the sides outside of the dies, which are of extreme dimensions in the present case, being intended for cutting out plates for electric armature discs up to thirty inches diameter.

The sliding head not only spans the throat, but is guided vertically in a very effective manner by extending the guide ways up almost to the center of the eccentric shaft, as seen in the drawing. The toggles or links are set at such a distance apart as will distribute the strain over the die plate as equally as possible. These last-named features for a press of the kind are marked improvements.

Cutting out metal plates of large size is by no means an easy operation. In the present case, for example, the perimeter of the die measures 94.25 inches, and if the metal to be cut is ⅛ inches thick, the area of the section is nearly 12 inches, or the same as punching a two-inch hole through a piece two inches thick. Of course the work is not the same, the pressure required being as the thickness multiplied by the diameter, but is a good deal more than would be inferred. The weight of the machine above, including a fly wheel not shown, is 15 tons.

IRON SAW-BENCH WITH POWER FEED.

THE EGAN COMPANY, CINCINNATI, OHIO.

We publish the engraving opposite as a good example of machine design, and also as a text for some comments on saw benches, or the manner of feeding the timber on them.

The Americans have the name of adopting automatic or "self-acting" apparatus to a greater extent than any other people, and it has always been a problem why saw-benches form a marked exception to this rule. One reason is that we do very little work on saw-benches compared to other countries, because timber is here sawn to dimensions when green, and there is but little for saw-benches to do,

but even this does not account for hand feeding when there is every reason, except one, for feeding by power in the manner shown, or in some other way.

The exception is that by hand feeding, or pressure feeding, it may be called, the saw is made to cut as fast as possible, and the rate of feeding is in proportion to the sharpness of the saw and the thickness of the wood, but neither of these things should decide the rate of cutting or of feeding. It is true a saw can be made to feed faster when sharp, but why should it be fed faster, and why should the feed be less when a saw is dull? The fact is that it is a problem of "pushing," and the result is bad work.

In England saw-benches are divided into rack, rope and roller-feed benches, and very few are made without some method of advancing the timber at an uniform rate. Such sawing is well done with very thin saws, and the manufacture of plain saw-benches for export trade is an extensive branch of business there. We export from this country a large amount of wood-working machinery into various foreign countries, but not saw-benches. People do not want to push the work by hand, and will not do so when they can procure power fed machines.

The present design has a number of good points, and one or two to criticise. The gauge should not extend, or at least not have a bearing, beyond the saw teeth in front. The racks for moving the gauge should be turned over with the teeth downward so as to keep clear of sawdust, and the feeding roller should be raised with a lever so as to be adjusted instantly. These, and other improvements have, no doubt, been made, because the engraving is not a new one. It might be, however, in so far as quality, for it is one of the best illustrations the Company has produced.

LITERATURE.

The Social Condition of Labor.

BY PROF. E. R. L. GOULD.

This essay was published simultaneously in this country, in Germany, and France, and is in many respects the most authoritative literature on the subject treated, that can be referred to.

The value of this work, aside from the ability and labors of the author, arises from the circumstances of its preparation. In 1888 the Ways and Means Committee of the House of Congress, requested the Labor Department of the Government to make in various countries an investigation into the circumstances of labor, the cost of production, wages, hours of labor, cost of living, and so on.

Professor Gould was chief of this commission, and is careful to explain at the beginning that the investigation had nothing to do with the late tariff act in this country, which can well be believed in so far as its effect upon that policy. The report was not completed until after the McKinley act was passed in Congress, and was not required for that purpose, indeed, would have refuted the principal argument urged in favor of that celebrated measure.

The present paper deals only with coal, iron, and steel, and is based on observations made in 454 American, and 164 European establishments, and from 2,490 American and 770 European workmen, not including laborers engaged in unskilled kinds of work.

The statistics here presented are almost the first and only data of an official kind, bearing upon the amount of wages entering into the cost of commodities, and goes to prove the proposition many times set forth in this Journal, namely : that the labor element in commodities is very nearly uniform the world over, the differences modified mainly and almost only by the relative cost of the other two elements of production, material and expense.

Our readers will remember the commotion caused by the publication of the present tables, or others containing similar facts, in the last report of the U. S. Labor Commissioner, the Hon. Carrol D. Wright, especially to the section relating to the cost of making steel railway bars. All the iron literature of the country attacked the matter as absurd, but now it seems that when applied to for information, the makers of steel rails in this country, with but a single exception, refused to furnish particulars of the cost of production, thus evading the objects of the inquiry, and admitting the insincerity of their claims of a higher labor cost.

We are at a loss to know how to deal with Professor Gould's paper and the tabulated data it contains, perhaps the best thing will be to recommend our readers to procure copies and read it, and this we do most heartily, but must spare room for a few brief quotations, one from the preface, as follows :

" It is strange that in an age when social questions challenge so largely the thoughts of men, little attention is paid to fact in comparison with dogma." * * *

"Neither dogmatists nor agitators have any love for the statistician, for the simple reason that he disturbs the dream of the one, and the occupation of the other. But I believe thoroughly that it is he who can find the key to most of the social problems of labor. His methods are the surest, as he devotes himself to the diagnosis of separate complaints instead of manufacturing universal cures." * * * * * *

"My chief aim has been to see comparatively how an ambitious, intelligent well-living laboring class fares in economic competition. This question is a crucial one, for if a high standard of life begets superior force, intelligence and skill, these latter can be depended upon to perpetuate themselves, and their exercise to react alike to the benefit of employer and employed."

In summing up the inferences to be drawn from the labor cost of certain commodities being no greater in this country than in Europe, although the wages are more, Prof. Gould says :

"The real explanation I believe to be that greater physical force, as the result of better nourishment, in combination with superior intelligence and skill, make the workingman in the United States more efficient. His determination to maintain a high stan-

dard of life causes him to put forth greater effort, and this reacts to the benefit of the employer as well as to his own. We should give the principal credit of the higher wages in America neither to the manufacturer, the tariff, nor any other agency, but the workingman himself, who will not labor for less than will enable him to live on a high social plane. That he can carry out his policy with but little disadvantage to his employer in economic competition teaches a lesson of far-reaching importance. Instead of a Ricardian regime, where the wages become barely sufficient to permit a sustentation of effort and a reproduction of kind, it looks as if ere long the world's industrial supremacy would pass to those who earn the most and live the best."

The essay contains 42 pages finely printed for library binding, is published by the Johns Hopkins University, Baltimore. Price 50 cents.

Traffic Report.

We have received from the Traffic Association, of California, the report of their executive committee, and of the traffic manager Mr. Leeds, that leads one to stop and ask if this is a "free country." The reports are too long to be reproduced here, but should be procured and read by every one interested. The Traffic Association, now a little more than a year old, labored up to present time, or near it, under the disadvantage of having its sincerity and good faith questioned by the public. People had become so accustomed to cunning schemes, always ending against the public interest, that a feeling of suspicion arose in respect to this association. The rumored withdrawal of some leading members, under the plea that one of the political parties had in their State Convention indorsed the Traffic Association cause, was certainly a suspicious circumstance, and if true, one that should be remembered in this State. The industrial "strangulation" of California is an old story, the truth of which now, for the first time in a dozen years, begins to engage the attention of the people. The opposing romance of "building up the State" by a private corporation, whose interests lie in another direction, are being found out and understood, so also are those who would sacrifice the interests of their neighbors for a personal advantage. The work of the association has been, when we consider the circumstances, extensive as it is important.

Triangular Surveys from Single Stations.

BY AUGUSTUS KNUDSEN, C. E.

This little work of thirty-two pages is devoted to an explanation of the subject embraced in its title, and to the profession, will no doubt be a welcome addition to existing literature on topographical methods. Those not technically skilled in the intricacies of triangulation, suppose it to be divided into geodetic and plain methods, but never imagine there are very different ways of procedure beyond this.

The author, after describing triangulation by Cartesian and polar coördinates, proceeds to explain the system of working from a single station, and says of it:

"I have used it, and caused it to be used, for over fourteen years in many descriptions of work, often of great importance; as for instance the contour survey of a mountain pass eleven miles in length, for the purpose of locating a chain of tunnels, that involved the fixing of four thousand points, and was despatched in a month and a half, office work included.

As there are at present interesting discussions going on throughout the country touching the topographical survey of different states, it is to be hoped that this additional view of the subject will aid in solving the economical problems at stake, perhaps even to opening a way for corporations to attempt the work by contract."

Described in an elementary way, the system of operating from a single station may be called triangulation "on its edge," with a vertical base, possible in nearly all cases, and a shorter, as well as easier method subject only to such variations of error as occur in plane work, except it be what the author calls the "errors of the vertical bases" and this, we imagine applies only when a station is chosen where altitude is difficult to determine.

Formulæ are given for resolving angles and determining errors of each kind, and are extended for convenience into tables of reference. Our knowledge of the general subject is not sufficient to estimate the advantages of the method in comparison with others for fixing points, but there is evident adaptation to the rough topography of this coast, and the further warrant of its successful application. The book is published by Brunt & Co., 535 Clay Street, and is sold for one dollar.

The Engineering Magazine.

MARCH, 1893.

In the present number, Mr. Barnet Le Van, of Philadelphia, contributes an article on the "Increase of Speed on Railways," the principal point of which is to set forth the advantages of locomotives having a single pair of driving wheels, which he terms for shortness "single engines."

The article will be read with much interest, not only by railway people, but by engineers and mechanics generally, because this subject of locomotives has for various reasons, become a popular one. The public travel with the engines, observe them, are interested in their performance, and it is an exception to find anyone who does not know something of locomotives.

Mr. Le Van enjoys the considerable advantage of looking at the subject generally without a local prejudice too common in discussing locomotives. His conclusions are in favor of "single" engines for passenger traffic, and his views are supported by many facts that go to show an economy in every way of this type over the double and triple coupled kinds.

Single engines are as rare in this country as they are common in England, and we will confess to a strong prejudice in their favor on "mechanical" grounds, but without pretense to understanding the many complex problems that pertain to their use. Engines of the kind have been made here, and as Mr. Le Van claims, made a good record, but as before said, are not used at this time.

The weight of passenger carriages, here reverted to, is an anomaly in modern practice. If one is to be hauled over a rough road, without rails, the carriages employed do not weigh more than the passengers, but as soon as they are mounted on smooth rails, the weight of the carriages is increased more than ten times. We will quote the concluding paragraph of Mr. Le Van's paper, as follows:

"In England the majority of fast passenger trains are hauled by single locomotives at a speed of 53 miles an hour with a consumption of 26 pounds of coal per train-mile, the weight of train being equal to our five-car trains, averaging 250 tons. The same weight of train in this country is hauled by a coupled locomotive at the rate of 43 miles an hour, with a consumption of over 50 pounds of coal per train-mile. The English locomotives average 85,000 pounds in weight, and the American locomotives 100,000 pounds. The driving wheels of the former are 7 and 8 feet in diameter and large exhaust nozzles, the former reducing the number of revolutions per mile, thus producing a slow draught, allowing the products of combustion time for passing through the flues, so as to give up the greater portion of the heat evolved, thus effecting a higher evaporation per pound of coal burnt; and the latter reducing the back pressure on the pistons, the concurrence of which is a great drawback to high speeds; the trouble is not to get the steam into the cylinder, but to get it out quickly. The American locomotive has small-diameter driving wheels and small exhaust nozzles, the former requiring more revolutions to the mile and less effect of the heat evolved in the flues, while the latter keeps the fuel dancing on the grates, and burns the fuel to *carbonic oxide* in place of *carbonic acid*, meaning a loss of fully 4,000 units heat per pound of fuel consumed. By the adoption of single locomotives the fast passenger trains could be moved as fast as the English at a saving of fifty per cent. in fuel."

These statements, if correct, are remarkable, and should engage attention.

Mr. Warner Miller, President of the Nicaragua Canal Construction Company, writes of that enterprise, as usual arguing the commercial expediency of the Canal. This subject has become stale. No one questions the commercial advantages of the Canal, operated at fair tolls. The problems requiring discussion now, are the methods and means of construction, also the relation the people and government of this country will bear to the work if it is aided by public money. An essay on this subject would have more interest and be more relevant to the part that a "construction" company is to have in the matter.

The contribution of T. Graham Gribble, on the annexation of Hawaii, contains a number of new points in this much written of subject. Among other things, it relates how the British Government seized the islands in 1843, and then returned the sovereignty the same year. One thing made clear, is that the people of the islands as they now exist, are a "missionary product," and as such, are not an enticing example of that influence which seems to include the introduction of vices and then resisting

them. The problem of what is to become of a weak people when a stronger nation gets a foot hold in their land, is here set out. There is no restraining influence but the moral sentiment of the world, and that does not count for much these times. It is a happy matter that this subject is to be taken up for deliberation at Washington, and by those who are likely to proceed with caution and fairness.

The Constructive Materials of Engineering.

BY PROFESSOR A. W. SMITH, STANFORD UNIVERSITY.

This little work, unique in dress, is in many respects a "departure," as we may say, in text books of our time. These come in cumulative frequency of the *vade-mecum* and *multum in parvo* kind, generally compilation — all good, but tedious by uniformity, and often unnecessary.

The present one breaks up the routine, for which one is thankful. It is as said, unique in make up, devoted to a single subject pursued from the beginning, and exhaustively. The graphic part consists of pen sketches, almost, or quite, "free-hand" made, and have a flavor of the shop and laboratory.

The author modestly remarks in a short preface.

"The object of the work is to give the student a start toward that understanding which shall enable him to select materials best adapted for machine parts subjected to different working conditions."

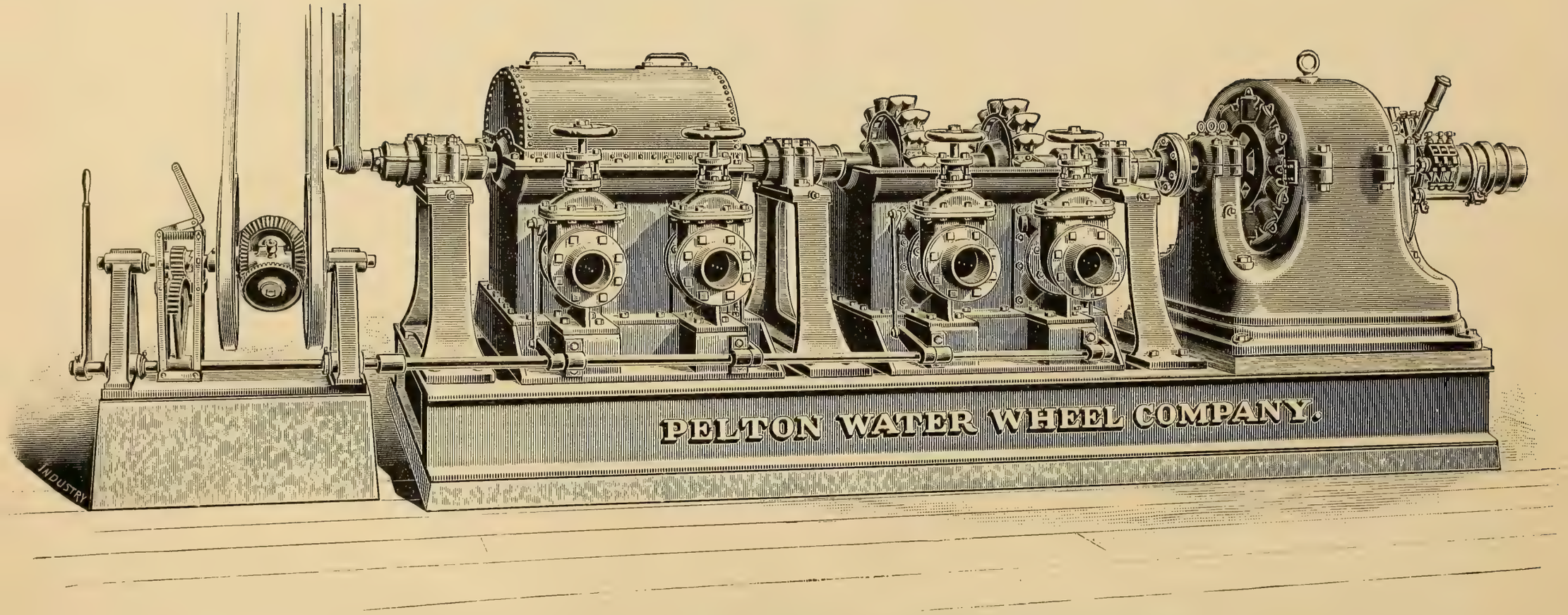
It would be more in keeping with custom to say that the student is conducted a whole journey, and return trip with diversions, and as a matter of fact, the claim would be reasonable, in as much as the whole treatise centers finally on the sixth chapter, called the "selection of material."

Selecting material, is by no means the easy matter people suppose. On the contrary it is a subject on which there is much diversity of both opinions and practice, also, thus far, continual change, and when we come to think of it, as Professor Smith has evidently done, there is no guide whatever, but custom, or empirical rules. Here we have, however, "reasons" for adopting one kind or another of material, and what these reasons are founded on, clear back to the crude or natural form of materials, and the processes of their conversion.

We once had occasion to criticise the title of Professor of "Machine Design," bestowed on Professor Smith when he joined the faculty at Palo Alto, but if the present treatise discloses his methods, we recall all doubts as to "design" being, in most respects at least, raised to the claim of a science, and an art to be professed. The present work is an answer to that criticism, and it is only fair to admit, places the matter in a new light. As the title indicates, it is confined to material, but there is no reason why other elements of design can not be made amenable to similar methods of treatment, and if Professor Smith will go on to deal in a similar manner with proportions, strains, friction, endurance of surfaces, transmission and adaptation, as he has with material, and group the whole under the comprehensive title of "machine design," he will have accomplished what has been only attempted under the same head by others.

We have gone on thus far and consumed our space without particular mention of the contents, and have only room to remark upon a scholarly diction in the work that is surprising. There is a precise use of technical terms, and of general expression, indicating education in a wider field than one country and one language permits. We congratulate Professor Smith, and recommend everyone engaged in constructive work of metals to procure the book and examine it. Price, 80 cents.

We wonder if the readers of INDUSTRY, or any other journal, ever considered the labor involved in this department. We do not pretend to a careful reading of the matter sent in for notice, and confess to some temerity in writing opinions that are in no case made up from other reviews. Lying before us now is a treatise of 800 pages on the "Theories of Structures and Strength of Materials,"— a world of mathematics and of work — by Prof. H. T. Bovey. Next month we must write an opinion of this work, but how form such opinion, and what will it be worth when formed? Perhaps the common way is the best, shelve the book and publish its title and price.



250 HORSE POWER ELECTRICAL GENERATING PLANT.

THE PELTON WATER WHEEL CO., SAN FRANCISCO.

[For Description, see Page 307.]

"INDUSTRY."

JOHN RICHARDS, EDITOR.

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COMMENTS.

The loss of the *Naronic*, White Star freight steamer, is the most remarkable marine event of recent times. She was 460 feet long, 49 feet beam, 6,000 tons register, 3.000 horse power, and first-class in all respects. She sailed from Liverpool at the end of February last, and has not been heard of since, unless a report of seeing one of her boats in mid ocean is correct. A great many conjectures have been put forth as to the probable causes of the destruction of the ship, and among them omission of what seems most probable of all, that she capsized, either by failure of her power to keep her head to the sea, or by reason of improper loading. The failure of her engines, or the failure of the engines of any ship in a storm may lead to her destruction. When disabled she will at once fall off into the trough of the sea, and by rolling, expose her decks, which will be crushed in. The deck of a ship is her vulnerable part. The surfaces being nearly flat are weak accordingly. The *Naronic*, being arranged for carrying cattle, would be numerously, but weakly stanchioned and more easily smashed in than a passenger steamer with strong and continuous bulkheads. Those who have gone through a severe storm in the North Atlantic will not wonder at anything due to the fury of the seas.

The discussions one meets with in various publications respecting ship building in this country, commonly deal alone with our ability to produce ships, that is, of the skill required, but this is not the problem at all. Ships can be built in any country, in China and Japan for example, and are built there. The skill required is a movable commodity and can be concentrated in any country where there are the proper inducements offered. The problem is the cost of material, maintenance, and dues or taxes. So long as a ship is taxed for making roads, sewers, school funds, police duty and criminal procedure on land, and then is taxed again for marine dues, hospitals, lights, pilotage, tonnage, enrollment, and other marine taxes, which no one on land pays, we cannot succeed with ships, no matter what skill is brought to bear in their construction. We have never heard, and do not expect to hear of difficulty in building ships in this country. It is the cost of owning and operating them that lies in the way.

The *Irrigation Age*, for March, contains a long account of the Kern County Land Company, which is not only one of the greatest corporations of the country in the extent of their operations, but also a peculiar one in their methods of business. The company control 489,900 miners' inches of water, equal to 8,000 cubic feet per second, and own 400,000 acres of land. They carry on fourteen large farms, and have under cultivation 97,000 acres of land. Their system of irrigation canals cost $4,000,000. They are twenty-seven in number, 300 miles of main or trunk lines, and 1,100 miles of lateral or distributing canals. These facts of immensity are surpassed however by two more important ones, namely, no bonds have ever been issued. The owners furnished the money for the work, and it is claimed that no one has ever had to complain of oppression or unfair dealing on the part of the land company.

Some wise person has said that "comparisons are odious," and it is to be regretted that the author of the saying, whoever it was, had not the power of enforcing his opinion. Few people consider the bad taste of comparisons, or observe their avoidance by all well bred people. The late Secretary of the Navy, at a club dinner recently, when there were a number of Germans present, boasted that the American Navy was superior to that of Germany, which with double the population, and twenty times the amount of sea coast is not to be wondered at, besides, we are distinctly inferior in

a much more important branch of the marine. The Germans have for more than twenty years past, been operating under our noses, one of the finest trans-Atlantic lines of merchant steamers to several of our principal sea ports without any government subsidy, and we must conclude that the Secretary's statement was in bad taste and "odious."

The discovery of the bacilli of tuberculosis or consumption, by Dr. Koch was a great fact in the progress of science, not only in respect to this fatal malady, but in respect to other diseases and means of successful treatment. Little is now heard of the lymph that caused such an excitement throughout the world, three years ago, but it is not dead, on the contrary is pursuing its even way of "evolution." These important discoveries never burst upon the world in a perfect form. They must pursue the inevitable course of slow and tedious development. Dr. Koch is not idle, neither are his friends, and the latest announcement respecting his treatment, or his line of treatment, is, that other physicians, especially Dr. Klebs, a German investigator, and Dr. Hunter in England, have so modified the lymph treatment as to avoid all the dangerous symptoms that formerly attended on its administration. Eighteen per cent. of those treated are cured, and there is much promise in future gain over this result.

One must note with amusement, rather than concern, in many of our trade publications the prominence given to reports of bad trade and declining industries in England, and is obliged to think that the authors of this literature are exulting over the circumstance, were it not the general rule to sell out to British investors whatever industry a purchaser can be found for. This can hardly be set down to sympathy, but rather to other less commendable objects. Those among our people who know the commercial constitution and policy of the British Empire or its head, the United Kingdom, attach little importance to a decline of industry, or even of trade there. When it is more profitable to manufacture and trade here, or in any other country, no matter where, British capital will follow and the profits will still tend to London, as they do now from Bombay the same as from Manchester. The resources of Sweden and Belgium are now to a great extent directed to London, so is a billion of dollars invested in this country, not to mention Asia, Australia, and Africa. The difficulty is that most people suppose the

Empire to consist of the United Kingdom, the capital so to call it, of 325 millions of civilized people. It is too vast a "machine" for popular understanding, and one in which our own interests are bound up in a thousand ways.

The Cincinnati Southern Railway from that city to New Orleans, was built by Cincinnati and leased to a company for a term of fifteen years at a rental of $800,000, $900,000, and $1,000,000 per year, for three terms of five years each. The lease was extended in 1881 and in 1882, the secretary and treasurer issued $300,000 of unauthorized bonds that were a loss of that amount, and this, with a falling off in earnings has put the road into the hands of a receiver. The construction of this railway by a city was an extraordinary scheme, and was commercially a success. It would no doubt have been so in all respects if the city had retained the management. There was, along from 1875 to 1880, a disposition to cut Cincinnati out of the railway routes from the North to the South by going around and to each side. The city accordingly constructed a road of their own to New Orleans, of course under unfavorable conditions except as to Cincinnati itself, because of dividing a traffic already provided for.

We are called upon so often to notice the purchase of machine tools abroad by the Carnegie Company, that very soon the matter will become stale news. The latest addition is a hydraulic forging press to be made in England. Just why, it is not easy to see, unless to save in cost. A forging press is little more than a mass of iron, distributed in a simple manner, not involving any feature except immensity, that is thought to be worth technical description, and there are firms here who would very willingly have undertaken not only to make such a press, but could no doubt have added improvements for the intended use. It is possible that some arrangement is made whereby the duty is remitted or modified on these machine tools, if not, then perhaps it is Mr. Carnegie's intention to patriotically add as much as possible to the national income, by paying in the customs taxes.

Industrial Notes.

The whaleback steamers in their course of evolution seem now to be settling back into the place that the best marine engineering skill has assigned to them. There was a "commercial margin" undoubtedly, in modifying ships to a strictly cargo basis, with a corresponding loss of seaworthiness, and, as we have several times predicted, the scheme is not likely to much disturb an art that has for ten centuries or more engrossed the experience and skill of the people of all civilized countries. No one has questioned the increment of load that could be carried at slow speed in a spoon-bow flat-bottomed barge, or even that a spar deck could be dispensed with under certain circumstance, but the questionable part was the extravagant claims of a "revolution in naval architecture," that went forth to the world at the time this uncouth form of construction began. There is a limit to utilitarianism even at this day, and we think posterity will see deep-water vessels very much in the same form they are now constructed, but of much larger size, and with some addition of speed. The lean bow and hollow stern lines cut heavily into cargo and earnings, but those who have had much travel in the North Atlantic are sure to see times when cargo is not the principal matter to be considered.

We usually, with due deference however, indulge in a little prophesy respecting new inventions that come forth to revolutionize existing practice, and did so when the "American engine" appeared, giving, as our readers may remember, some history of the "swash-plate" type of engines, and remarked upon the vice of roller bearings, which was a feature of the engines above named. The company who made them we have every reason to think are conscientious and upright business men, and are sorry to note that the works have shut down for the present. It is only suicidal to strike out in such novel lines of construction, which the ablest engineers condemn, and the sooner the makers of the "American engine" get back to the conventional lines of accepted good practice the better. There are inherent faults in all kinds of piston movements when such movement is not absolutely uniform over the bearing surfaces. The same rule applies to all surfaces working under pressure, and this far the only way of conforming to this rule has been to move pistons backward and forward in plain parallel cylinders.

Messrs. Queen & Co., of Philadelphia, makers of scientific instruments, have taken up the manufacture of steam engine indicators, steam and pressure gauges, and thereby have entered a field in which they will meet much competition. The point to which we wish to call attention is the employment of deflecting springs for the indicators. It is possible, but hardly so, that Messrs. Queen & Co. can so prepare a deflecting spring that will not break, and will give regular ordinates of strain, but we doubt it. The fact is, deflecting springs of all kinds are unnecessary, and a kind of mechanical nuisance. The accuracy of fitting now-a-days permits the use of pistons resting on elastic fluids, and other devices to produce elastic resistance, and the field is wide enough without employing deflecting springs.

The two new Cunard ships, the *Campania* and *Lucania*, are fitted up with metallic berths, and the question is, why not? One hardly ever sees a bedstead of wood in England, and the wonder is that the same practice has not been sooner carried out in ships. These metal berths are exceedingly fine in appearance, with bottoms of woven wire, and ornamental panels in front. The various members of the framing are cylindrical so there are no corners, and the whole seems to fit in, and harmonize with, the ship itself. The principal berths are so arranged that when the mattresses are raised the front rail shuts down beneath, so the lower berth is at once converted to a sofa, or in smooth weather the "rail" can be dispensed with in the upper berths also, if the passenger prefers.

The Mersey Dock and Harbor Board at Liverpool, England, are now having constructed what will be the largest dredging machine ever made. It is on the suction or centrifugal plan, having two pumps with pipes 36 inches in diameter. The vessel is to be of steel, 320 feet long, 46 feet 10 inches beam, and register 2,560 tons, and is of the highest class of marine construction, so as to be listed with other vessels. There are eight hoppers, holding altogether 3,000 tons of sand, which is the material dealt with. The plans contemplate the filling of these hoppers, steaming out to the dumping ground and returning in one hour, so the capacity for ten hours will be 30,000 tons. The board are now carrying on a similar operation with a smaller machine, and are so well pleased with results that this larger one has been ordered and is now being constructed by the Naval Armaments Company at Barrow.

Mr. Charles P. Yeatman, a civil engineer with nine years' experience in Central America, mainly in railway surveys and construction, writes in the *Engineering Magazine* of a Pan-American railway between North and South America, and we think his views, and the facts presented, should settle that chimerical scheme. He points out how the distances are greater by land than by sea, and the cost of transporting passengers and freight would be at least double as much by rail, provided a railway could be built through Central America at all, which he doubts. The accounts of constructing and maintaining the railways now in Colombia should settle the matter. Mr. Yeatman surveyed a route from near Honda to Bogota, on the Magdalena River 600 miles, through a swamp 20 to 100 miles in width, and says it would cost $50,000 a mile for a cheap road, and the traffic would not pay for half the repairs alone. In conclusion he says that if a railway was built through the Isthmus countries no company in the world would maintain it for the traffic that would pass over it. This Pan-American railway scheme, as here described, is much like De Lesseps' canal in practicability, and even if possible has no object, because the water lines are shorter.

Professor Unwin in his late lecture before the Society of Arts, London, on "The Transmission of Power from Central Stations," managed to say a good deal that was new under a head that is nearly as badly worn as "Technical Training." The main point shown was the loss by operating engines at less loads than they are intended for. For Corliss engines, one test at Creusot, France, showed as follows:

Load of Engine	1	¾	½	¼	⅛
Efficiency, Condensing	.82	.79	.74	.63	.48
Efficiency Non-condensing	.86	.83	.78	.67	.52

With gas and petroleum engines a test made at Dresden, in Germany, showed even greater loss by reduced loads as follows:

Load of Engines	1	¾	½	¼	⅛
Gas per Horse Power per Hour, feet	22.2	23.8	28	40.8	66.3
Petroleum used, lbs.	0.96	1.11	1.44	2.38	4.25

As these results do not much depend upon the kind of engines, it can be assumed that the loss by light loads is quite constant in all cases. In respect to the proposition of Mr. Druit Halpin for storing heat in water, which we noticed last month, Professor Unwin showed, as we predicted, that it would cost about $10 per horse power for such a plant, against $1.25 for storing gas and $1.15 for electricity.

The *Engineer*, London, says that not one of the recent fast men-of-war could cross the Atlantic at full speed, that is, could not carry fuel enough to run 3,000 miles at full speed. It is true merchant steamers can do this at as great speed, or even greater, but they are not loaded down with armor and guns as battle ships are; besides, the war steamers have more beam, and cannot be modeled for speed. By Froudés rules, an increase of speed one per cent. calls for 2 per cent. of added length, 6 per cent. in tonnage, and 7 per cent. of power. This is very wide of public opinion in this matter. Length or size of a vessel is an obscure factor in the case, not easy to explain.

A proposed new scale for wire gauges to be presented for confirmation by Congress as a national standard, will be a wonder in meteorology, not only in its divisions, which correspond to no measure on or under the earth, and with a nomenclature unpronounceable and absurd. For example, the first numeral is "0000000," whatever that may be called. This means half an inch, and is one dimension out of two in the whole list that can be expressed in the common divisions of an inch. The other is a factor of this .25 inch, which is, no doubt, an accident. In the fractions of an inch we have $\frac{11}{1280}$, $\frac{17}{2560}$ and $\frac{13}{1280}$, with corresponding decimals such as .006640625. The base seems to be the number of ounces in a square foot of sheet metal corresponding to the gauge numbers, but even this varies to halves and quarter of ounces, but ounces are a unit not often employed in commerce or computation. Take it all in all it is the most complete jumble ever invented, and if presented to Congress should be held until Governor Knott, of Kentucky, will be available to make a speech on the subject.

There is notice in some of our exchanges of the method for ventilating the Carnegie Music Hall, at Pittsburgh, where the fresh air is sent in at the top and escapes at the bottom of the hall. This it seems is done to keep the air pure at the top, where the foul air accumulates and is commonly discharged. If that object is attained there is merit in the system, but we fail to see the theory on which such a result is based. The disposition of the air strata, to so call it, in a room is dependent upon temperature, and the warmest air will go to the top, whether fresh air be sent in there or elsewhere. The impulse or inductive action of air currents supplied for ventilation is too weak to have much to do with the disposition of the con-

tained air in a hall, or the circulated air as it may be called, and if there is any advantage in top inlets, it lacks the warrant of inference at least. If the air injected is cooler than that in a room, it instantly descends to the bottom, and in descending will not much affect the fixed volume in the room.

The Worthington Pump Company, of New York, are the first to prepare engravings of their exhibit at the World's Fair, at Chicago. It will be an immense one, including water-raising apparatus for 24,000,000 gallons a day, which is contracted for as a portion of the general supply for the exhibition. The largest engine will raise fifteen million gallons a day ; another engine, eight millions. These exhibits will be in a separate and special building, and will rank among the principal ones of all kinds, and certainly be the most extensive in the class. The conversion of direct-acting steam pumps to machines of high economy, is an American invention. Crank motion has for all time past been thought indispensable, and is perhaps best, if the water is to be moved by "jerks." Direct acting engines are the most scientific modification.

The *Marine Review* in a recent issue published a plate of drawings that is the most remarkable "exhibit" of marine engineering progress that has been produced. It represents the engines of the U. S. Steamer Powhatan, built in 1849, and of a modern torpedo boat, of like power, built in 1891. The following quantities will show the contrast, or at least give an idea of it, but the drawings convey a much better impression of the changes.

	Powhatan	Torpedo Boat
Horse Power	1,172	1,800
Steam Pressure	15 lbs	250 lbs.
Weight of Machinery	508 tons	45 tons.
Weight per Horse Power	972 lbs	55 lbs.

The proportions are as follows: Steam pressure as 16.6 to 1 ; weight of machinery 11.3 to 1 ; weight of machinery to each horse power 17.7 to 1. This is not only a revolution, but is transition to a new field altogether. The change is primarily in greater pressure and piston speed. The reduction in weight, it will be seen, is approximately as the increase of steam pressure. The relative rate of rotation was perhaps as one to fifteen, and the piston speed as 10 to 1. The elements entering into these two machines are the same in every respect, the difference is "evolution."

LOCAL NOTES.

We have received from Mr. F. H. Livermore, of the Folsom Water-Power Company, a fine collection of photographs showing the construction of the dam, aqueduct, power houses, and other details at Folsom. The purpose is to convey to the City of Sacramento, by means of electricity, a portion of the power derived from the works, and tenders for the electrical plant have been asked for from several companies engaged in that line of business, especially the General Electric, Westinghouse, and Siemens & Halske Companies. The Water-Power Company have a fine property, and the improvement in its ultimate results will be among the most noted in this State, especially if the transmission to Sacramento is successfully accomplished, and of this there can be no doubt. The present limitations of electrical transmission, especially as to first cost, will soon permit the utilization of such sources of power in this State, and the increase of power consumption will more than keep pace with the supply, so it is not likely that plants now put down can ever become unprofitable. Water raising for irrigation might alone consume all the power that our mountain streams afford.

The newspapers have succeeded in filling out a good deal of space with the "*Monterey's* boilers," the *New York World* furnishing the raw material. These boilers so far from being ruined come out of the forced trials in better condition than in the case of the other vessels. One boiler was perfectly tight, the other developed some leaks around the tubes, as all new boilers are expected to do, and required only re-caulking after the furnaces were cooled down. On the British ship *Vulcan*, built at Portsmouth, and just now got into commission, the tubes leaked so badly on her first trial trip as to prevent any definite result. There neither is, nor was, the least grounds for the foolish report in the *World*. On its appearance the contractors requested the department to order the *Monterey* out on a long run as the quickest way to determine the condition of her boilers, also have asked for an official examination of them. The best way in all such cases is to wait for the word of journals and people who can distinguish between a steam boiler and a water tank. This no one on the staff of the *World* is likely to do, and the remark applies to the newspaper press generally. We will add that

the communicating valves in the pipes of the *Monterey* all shut automatically against backflow, so the ground work of the *World's* story is a myth.

The Fulton Engineering and Shipbuilding Company, of this City, are progressing with their new plant on the north coast, and have now in place, and in use, a number of high-class heavy machine tools. The situation, which we have recently examined, is especially favorable. The land is level, and composed of fine sand, which, all things considered, is the best possible foundation for such a works. It is easy to manipulate, packs firmly, and is always dry on the surface. At the Fulton Works some observations of the action of the currents has led to a considerable saving of expense. The sand is cut away in one place, and deposited in another by the currents, in a strange manner that no one would suspect. In one case a filling of stone by disturbance of the current produced an excavation not wanted, and the method was changed accordingly. The basin, a commodious one, has become deeper at the edges of the wharves where filling was expected. In fact the action of water on the drift sand is a mystery following some strange rule not well understood. The company will have a most advantageous position, and will now concentrate their business in the coast plant as rapidly as possible. The works are reached by the cable-railway lines, and are as near to the business centre of the City as is desirable.

ELECTRICITY.

NOTES.

The *Electric Review*, London, has been prosecuted by a medical doctor, who was taken to task for his endorsement and recommendation of an "electric belt," which the *Review* pronounced a humbug, or words to that effect, and the doctor's certificate "a reflection on the intelligence of the medical world." The doctor was supported by the Electropathic Institute, where the belts were made, and a trial was held, during which Lord Kelvin, and other eminent electricians, testified that no current could be generated by a belt on the body. The jury returned a verdict in favor of the *Review*, and the decision was hailed with loud applause. The *Electrical Review* then instituted a counter suit against a "medical battery company"

for charging malicious libel against the journal, and won the second suit. It is discouraging at this day, with all the electrical literature that is floating over the world, and the amount of elementary knowledge that should exist, that these electropathic schemes should deceive people, then again perhaps not, when one looks over a list of the soothsayers and prophets advertised in the daily papers.

Industries, London, has engraved a number of views illustrating the electrical power plant at Tivoli, in Italy, from where the power is conducted seventeen miles to the city of Rome. It is a very remarkable plant, consisting of Girard turbine wheels generating 2,700 horse power under a head of 300 feet. The water is taken from one of the old Roman aqueducts that terminates in a tower, down which the water is taken in a pipe 130 feet long and 63 inches diameter. There are nine water wheels of the pure Girard type, running at 170 revolutions per minute, and are placed on the same shafts with the armatures, which are 7 feet 3 inches diameter. The transmission is by four cables, made up of 19 strands of No. 12 wire, the weight of all being over 100 tons. The works were constructed by Messrs. Ganz & Co., of Buda-Pesth, Hungary, and from the drawings seem to be very complete and well arranged. The currents of transmission are to operate at a pressure or force of 5,100 volts for a part of the way, and are then reduced to 2,000 volts.

The Pullman Company, of Chicago, has given an order to the American Storage Battery Company there, for 380 cells specially made for a car to be employed by Mr. Pullman in his journeys to New York. The car is to be driven by an electric motor at a rate of 60 miles an hour, and will perform the journey in 16 hours. Mr. Armstrong, of the Electric Storage Company here, computes that the stored energy will drive such a car for 20 hours, but the charge is not wholly relied upon. There is a supplementary plant for generating that will come into use on grades and curves of much resistance. The batteries employed are of a new form, on the Plante system, in so far as functions or the manner of operating, but of a wholly different construction. The Plante cells required months to charge, while the new form can be charged in eight hours. This car or train will no doubt be one of the chief electric features of the exhibition, and of its time. We are not able to describe the new storage batteries, but examples of them can be seen at the Electrical Storage Company's offices, at 120 Pine Street, in this City.

Mr. Telsa's late lecture in St. Louis on electrical phenomena, called out an audience of four thousand people, many of them paying five dollars for seats, this shows a remarkable interest in the subject, and perhaps a good deal in the lecturer, who in some lines of investigation stands pre-eminent at this time. He repeated with additions his vacuum tube experiments, that go to show the presence of "ether" or some pervading element we call ether, of which there is accumulating evidence of various kinds.

The Niagara Falls Power Company have solicited tenders for a horizontal dynamo of 5,000 horse power, the armature of which is to be mounted on the top of the turbine shaft, now being constructed in Philadelphia. A number of bids have been made, two in this country, by the General Electric and Westinghouse Companies, and three from abroad. It is to be hoped the work will be made here, and certainly ought to be, unless there are some features that require previous experience in this kind of generators. The Oerlikon Company, in Switzerland, have recently executed an order for similar dynamos, but of smaller size, being of 400 kilowatts capacity, and requiring 500 horse power. Four of these were made for an aluminium smelting company at Newhausen, where nearly 4,000 horse power will be consumed by the company for smelting or producing aluminium. In this case the weight of the armatures, shafts, and wheels is balanced by the water pressure, and the whole when running, is in equilibrium. The armatures weigh 21 tons, and one of ten times this capacity will be a formidable weight.

New "ideas" in respect to electricity are growing more scarce. The field has, to use a metaphor, been so beat over, and so persistently have people talked, speculated, and conjectured, that ideas are far ahead of accomplished facts. One of the latest, which is in nature almost a simple truth, is that we do not generate electricity—only accumulate it. The original stock of the fluid, so to call it, pervades everywhere in endless and undiminishable quantity, but unfortunately we have to this time discovered no means of collecting it, except by the expenditure of motive power or energy. The novelty of this proposition is impaired by claiming the same thing for natural forces of all kinds. There is an endless amount of heat represented in the carbon of fuels, but we have to burn them in order to use it.

MINING.

NOTES.

The Selby Smelting Company, on Carquinez Straits, have received from the Harquahala Mines, Arizona, an ingot of gold that weighed 379 pounds, and was worth $96,168. It is about 6 ×14×8 inches, and is the clean-up of 54 days' run at the mill. This is a safe way to ship bullion. No one is likely to pick up and run away with a "bloom" of nearly 400 pounds weight. In fact, such a mass is safe in almost every way, but there is a difficulty in providing material for the original manufacture.

There is a common impression that the low price of silver has, to a great extent, stopped the mining of that metal, but the output in Colorado last year increased 3,000,000 ounces. This was due in part to the discovery of many new and valuable mines in that state, especially at Creede. The cost of producing is on an average of 40 cents, in some cases falling to 15 cents an ounce. Of course a special case proves nothing, or not much, but this is a large case, and the results must be spread over a general average. The price of silver, despite all laws and coinage acts, will settle down to the cost of production, whatever that may be, and is, no doubt, low enough at this time.

The *Engineering and Mining Journal* points out that Mexico is the greatest silver-producing country, if the whole product of the world is considered, and that the district of Guanajuato, opened in 1548, has alone produced about $650,000,000. Another group of mines 12 miles distant from Guanajuato has, in the same period, produced $312,860,000, or for these two districts nearly a billion of dollars. Fuel is dear in these districts, coal $22 per ton, and wood $10 per cord. Some of the shafts are of large size. One at Guanajuato is 40 feet in diameter, and 1,400 feet deep. The re-opening of Mexican mines, which will some time take place under the influence of railways, will be a potent factor in determining the price of silver, in fact has now an influence in the way of a possible source of future supply.

"One of the largest silver-producing mines in South America, if not in the world, is located on the central table lands of Bolivia at an altitude of 13,400 feet. A depth has been reached of 1,190 feet below the level of the main tunnel. The outlet is by a narrow-gauge railroad to the sea coast, spanning a distance of 395 miles. Total production in 15 years, $46,000,000, of which stockholders got $15,000,000. The company's report for 1891 shows a product of 5,942,000 ounces. The ore assays from 120 to 300 ounces per ton, the higher grades of which are shipped to Europe for treatment."—*Mining News, Seattle.*

The increase of the gold-mining industry in Butte County of Northern California is a singular circumstance, caused not so much by discovery, as by better methods and organization. The quartz mines, which are now the chief branch, have not, as in most other districts, been all the time undergoing improvement, but were really abandoned for a time, are now taken up again. Some time the subaqueous gravel at the mouth of the Feather River will be worked. and this will add enormously to the product there. The feeble attempts this far made to reach the gravel should not be discouraging. The late L. L. Robinson was once concerned in such an undertaking, and he would have succeeded, no doubt, if he could have given the work his personal attention.

The Sutro Tunnel, at Virginia City, with all its ramifications and connections, foots up about nine miles in length. The main tunnel is four miles long, 10 feet wide, 8 feet high. The revenue to support this great work and pay interest on the investment, is derived from a direct tax on the ore raised from the different mines drained by the tunnel, the rate being formerly one dollar a ton on good ore, and 75 cents a ton on inferior ore. The tunnel drains into the Carson River, and is about 1,600 feet below the surface in Virginia City, so this height is saved in draining the mines. The electrical plant at the Chollar Mine is the principal mechanical wonder at the Comstock. There is a surface power at this mine from water brought thirty miles, and stored 460 feet above the works. This water is applied on a Pelton Water Wheel 11 feet in diameter, and is then taken down to the Sutro Tunnel and again applied under a head of 1,600 feet to six Pelton Wheels for generating electricity that is conveyed back to the surface and applied in the mills.

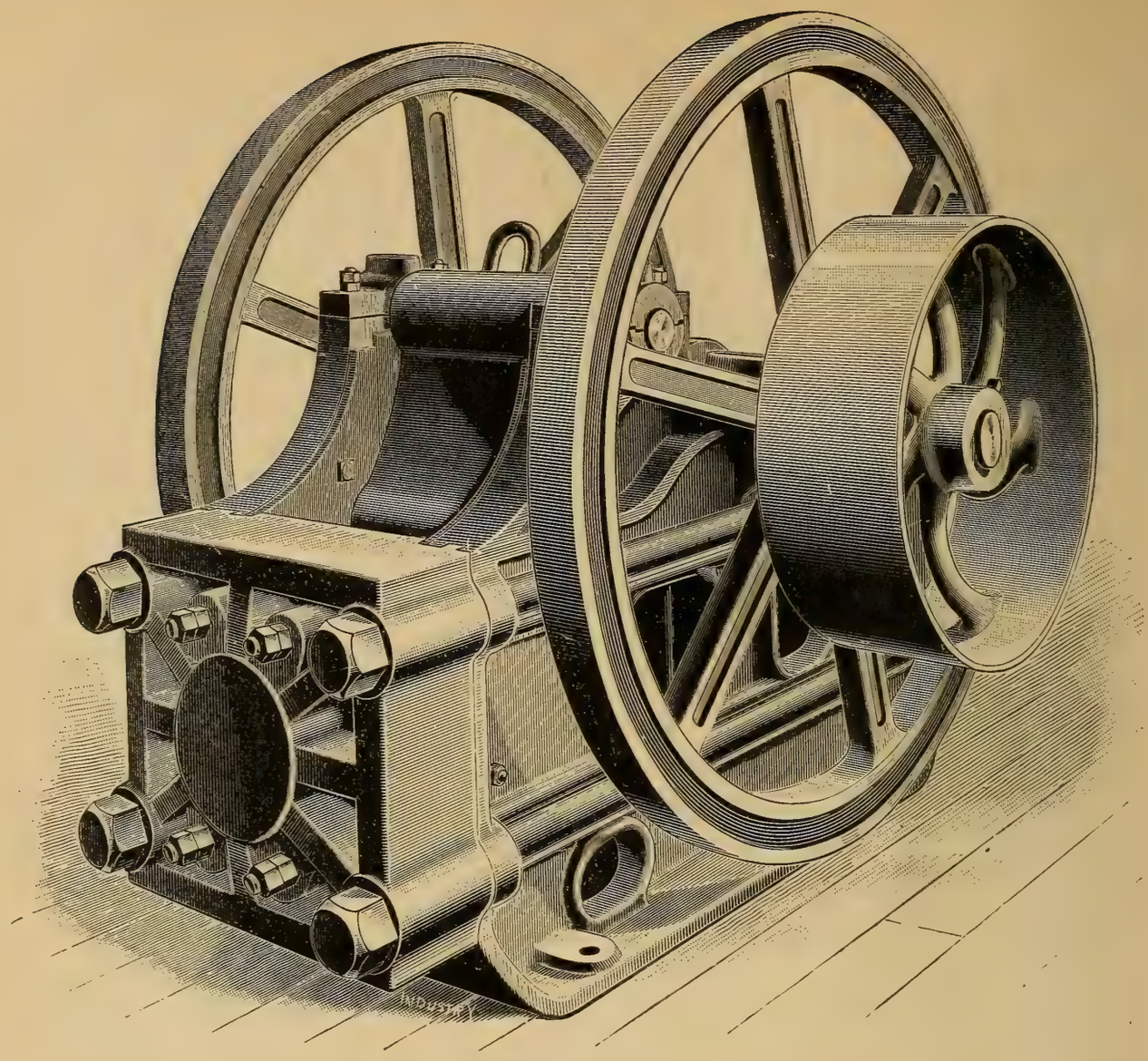


FIG. 1.

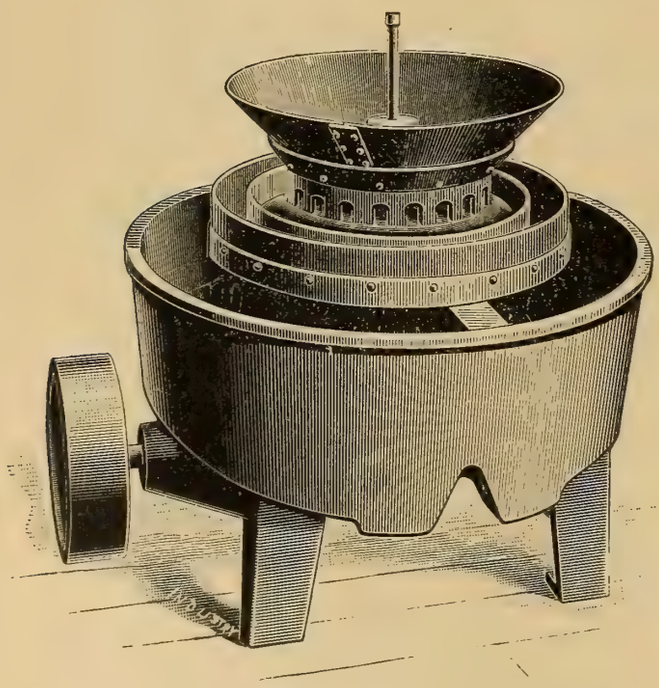


FIG. 2.

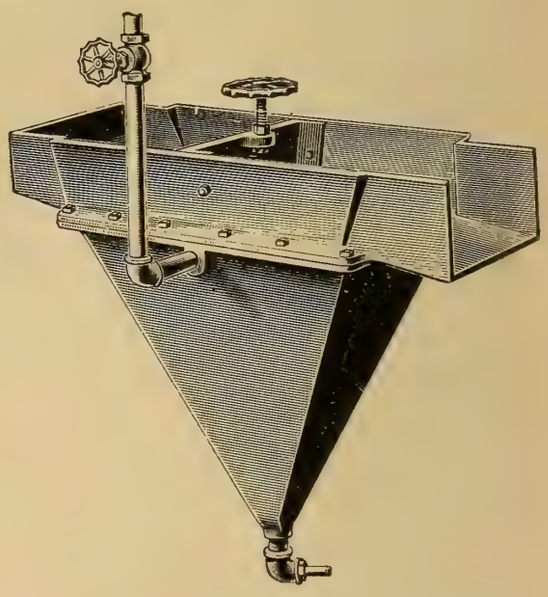


FIG. 3.

NEW MINING MACHINERY.—THE PARKE & LACY CO., SAN FRANCISCO.

NEW MINING MACHINERY.

THE PARKE & LACY COMPANY, SAN FRANCISCO.

On the opposite page are shown engravings of some newly designed mining machinery, by the Parke & Lacy Company, of this City, from plans by Mr. M. B. Dodge, the well-known mining engineer. Fig. 1 shows a stone and ore crushing machine of the standard type, known as "giant machines," with various improvements in details and construction that can in most particulars be followed out in the drawing. The tensile strains are taken up on the heavy wrought iron side rods, which permits a more symmetrical form for the framing, with greater strength and less weight.

Fig. 2 shows a distributing machine that divides equally the sand or pulp and water as they come from the battery on the way to the concentrators. In cases where a battery feeds two or more concentrators, adjustable diffusing guides are employed, but these cannot be relied upon, because, by clogging, one concentrator may be supplied with sand and another with water, but with the present machines the pulp is swept over gratings or perforations in the bottom of the revolving pan, uniformly mixed, and is then cut out by dividing plates or diaphragms, one of which is seen in front, and is thus separated into two or more equal parts of sand and water that flow out of spouts at the bottom and to different concentrators. In this manner concentration is equalized and uniform, producing better work, and an increase of capacity.

Fig. 3 shows one of Dodge's improved hydraulic sizing machines, which by hydraulic selection discharges the fine material at the wide spout at the top, and the coarser material at the bottom. It is a refinement, so to call it, on former machines for the same purpose.

SHIP-CANAL TOLLS.

Mr. Geo. W. Dickie, of the Union Iron Works, who, it will be remembered, presented here, last year, a scheme for operating lines of freight-carrying steamers between San Francisco and Liverpool and New York, including carefully worked out tables to show the cost, expenses, and all the operating conditions of such a line.

His estimates were questioned at the time, and were defended in a lecture delivered at the Academy of Sciences, as will also be remembered. Since then these estimates have been submitted for examination to people, both here and in Europe, skilled in this

branch of business, and the result has been that not only were his estimates confirmed but reduced in some cases, and on the strength of this two firms have subscribed $200,000 of the capital for such a line.

Our mention of this matter here is to repeat and remark upon some of Mr. Dickie's opinions in respect to the effect of the Nicaragua Canal, or other trans-isthmus canal, upon a line of steam ships as proposed. He claims that the cost of carriage by steamers around South America, from one end of the canal to the other, will be less than the minimum tolls that are proposed, that is $2.00 to $2.50 per ton. He also claims that freight can be carried profitably for a little less than five dollars per ton from here to New York by the Straits of Magellan, but the strangest part of his computations relate to the effect of the Suez Canal on such long steam journeys.

The wonderful economy attained in modern steam carriage at sea, Mr. Dickie claims is a result of the Suez route to India. Previous to the time when this canal was available, no one thought of carrying freight to India by steam, and all the trade was performed by sailing ships. The canal made steamers possible, and straightway there was begun a struggle to cheapen the cost of operating steamers that has brought about wonderful results. The amount of fuel has gradually been reduced until one pound of coal to each horse power per hour is clearly in sight, and the saving is in fact more than one half of what was burned when the Suez Canal was opened.

This economy of fuel, in conjunction with various other improvements and savings, is such that it is becoming a question whether it is not cheaper to sail around the Cape of Good Hope, and avoid the tolls in the Suez Canal? Last year fourteen steamers went around that way, and supposing, as is in every way reasonable, that a farther economy is to be looked for in ocean steam traffic, the tolls on the Suez, and also on all other ship canals, will have to be lowered accordingly.

This is a subject that needs some consideration in connection with the proposed Nicaragua Canal. If the tolls on which the earnings of the canal are based, is one half the cost of carrying from here to New York, it will be a good deal cheaper to go around South America than through the canal for all kinds of freight that does not require speedy transportation. As the cost of carrying at sea is reduced, so must be the tolls of ship canals, otherwise the traffic will not go through them.

250 HORSE POWER ELECTRICAL GENERATING PLANT.

PELTON WATER WHEEL CO., SAN FRANCISCO.

The finely engraved frontispiece in the present issue is taken from an electric plant recently constructed by the Pelton Water Wheel Company, of this City, for generating power at one of our principal mines, and is typical of a number of other designs for electrical plants made by the company this year.

The main drawing is so clear in respect to nearly all features that description is not required, but the regulating mechanism, which is not completely shown, should have some explanation.

On the small shaft, set at the left of the machinery, are two loosely mounted pulleys. One driven from the main water wheel shaft, and the other from a small independent motor or wheel without load and having a constant resistance. These two pulleys are driven in opposite directions and connected by bevel wheels as shown, the middle pair being attached to the shaft, so that when both pulleys are moving oppositely at the same velocity, the middle wheels and the shaft are still, but the slightest change in the relative velocity of the two pulleys at once turns the shaft on which they are mounted. On the end of this shaft is a pinion gearing into the toothed sector mounted on the motion rod seen in front, which is connected to wing valves in each of the wheel nozzles, governing the flow and speed accordingly.

This is called the differential method of regulating, whereby the position of the controlling valves depends directly on the relative speed of the two water wheels, or the relative position of the two pulleys. In other words, the main wheels must follow or conform in their speed to the independent motor, which is not subjected to any irregularity of resistance.

The novel feature in this regulating gearing has been the subject of a recent patent, and has proved very effective in several cases where it is now applied.

The wheels shown generate 250 horse power under a head of 340 feet, the water being conducted through a pipe 3,000 feet long. The dynamo is of the Westinghouse type, a twelve pole alternating generator, to run at a speed of 860 revolutions per minute. The wheels are in this case made smaller in diameter than usual, and increased in number, to meet the requirements of the dynamo in respect to speed, head, and power.

VOLCANIC PHENOMENON.

The topography of the country to be crossed by the Nicaragua Canal forms an exceptional geological study. In a recent article on the subject in *Engineering*, London, it is claimed that the inferences from observation, as well as Indian traditions, that volcanic disturbance has thrust the basin of Lake Nicaragua 150 to 200 feet above its former level, and that the lake once drained into the Pacific instead of the Atlantic Ocean. The Indians, as well as the early Spanish settlers, say that an open water way existed from the Pacific through an estuary connecting Lake Nicaragua and the channel of Tipitapa through Lake Nicaragua.

Humboldt says no spot on the earth is so full of volcanoes as this one between the 11th and 13th degrees of north latitude, and so subject to convulsions from volcanic causes. The Lakes Nicaragua and Managua naturally should drain into the Pacific. The geographical environment indicates this, and that the channel of the San Juan River and its valley are the result of a volcanic rift of recent times.

These are strange propositions scarcely to be understood or conceived of by those who reside on more stable portions of the earth's crust. The recession of the waters in Lake Nicaragua is another matter that may concern a canal there. In 1733 the lake level was 133 feet 11 inches above the Pacific Ocean. In 1803 the water had lowered to 103 feet 10 inches, or in 70 years had changed its level 30 feet 1 inch. This subsidence is yet going on, showing the natural supply is overrun by the draining of the San Juan River, and the level lowered by the erosion of that stream. Old accounts of the matter say that in 1550 there was only one rapid in the river. Now there are nine. The construction of a canal demands consideration of these facts, and also should take into account the almost certain disturbance by earthquakes of works constructed of masonry on the line of the canal.

In 1514 Pedrarias Darien explored both sides of the isthmus that bears his name, searching for a water communication between the two oceans. He founded the City of Panama in 1514, and was the first to acquire information concerning the lakes that lie between the oceans.

Mexico was conquered by the Spaniards under Cortez in 1519, and in 1520 the Straits of Magellan were discovered. In 1521

a new search began for a waterway across the isthmus, various lakes were discovered also tribes of Indians visited, one of which was ruled over by Nicarao, and the largest lake was called "Nicaraoagua," or Nicarao's water, now contracted to Nicaragua.

SAN FRANCISCO STREET PROBLEM.

The engineers of the Sewer Commission, Messrs. Manson and Grunsky, have collected at the City Hall, some exhibits to show how the present sewers of this City have been constructed, also some diagrams to illustrate how the grades at various points are at fault. These things are of the most rascally nature, and show that the contract method of constructing public work is not only a failure, but it is a theft of funds provided for that purpose. The sewers provide in some places large cesspools. Under Van Ness Avenue for one case, the grades, or rather inlets and outfalls, being such that from one to two and a half feet of filth is impounded. The masonry, which is illustrated by numerous examples of mortar, or pretended mortar, taken out of the sewers, also concrete work and sewer pipe. The pretended mortar is sand, the concrete a soft friable mixture, and the vitrified pipes, baked clay that can be pulled to pieces with one's fingers. If the report of these engineers does not lead to reform in these matters, it will be time to reorganize the "Committee of Safety."

To collect and disburse public money for such work involves not only the question of morals and bad faith, but the public health, and now that some portion of it has been got into the hands of reputable engineers, the rest of it should as soon as possible be disposed of in the same manner.

Someone must be responsible, and to be responsible, must have charge of this public work, and there need be no trouble in the matter. If required, a thousand men can be set at work in a week's time under competent engineers whose honesty is above suspicion. It is only a question of performing public work as private work is done, and removing it from what is called "politics."

It is nearly impossible under a centralized system of city government to attain an honest and efficient conduct of street construction and maintenance. If each ward of the City maintained its own streets, and the tax payers could see and feel the method of using

their money, also what they receive for it, there would be no such bad work done, but when taxes are put into a general fund, people are indifferent and do not appreciate the enormity of an improper use of the money.

We have lived in cities where each district maintained its own streets, had a yard for implements and material, and employed an engineer to manage the work. In the mornings as citizens went to their business they would pass and examine the street work going on, and consult with their engineer. These men took the same interest in the disbursement of their money in this manner that they did in what was paid out in their offices, and the result was the maintenance of perfect streets at half the cost of any general system.

One of the daily papers in this City, in a late issue, gravely informed its readers that the covering of the streets could not be supported on sand and mud, and that a substructure was required. The circumstance is mentioned to show where public indifference has drifted to in this matter. How else is a street to be made, and who, outside of our American cities, ever heard of a street made otherwise than with a substructure and a covering on the top? In Paris the streets have from eleven to twenty inches of broken stone and concrete work beneath the covering. In London various kinds of covering are employed, wood, asphaltum, stone blocks, and so on, but this has nothing to do with the street proper, which is beneath. The information above given is some thousands of years too old, but is no doubt news to many people, otherwise would not be set down as such.

As to hidden work beneath the streets, what can be expected of that, when the surface, looked over every day by the citizens, is made in violation of precedent, common sense, and without any view to economy or endurance.

Reverting again to the sewer problem, one answer to the work of the present advisory engineers will be, what assurance is there that their work and views will be reliable? The answer is easy. They have for many years past been engaged in planning and conducting both private and public work, and their record is open to show what this service has been; is not only open, but known, and the people have no fear of either their professional ability or their good faith. Their report will appear before long, and if properly disseminated, will no doubt mark the beginning of a reform in the system of sewerage of this City.

THE RICKS DECISION.

Doctor Raymond in the *Engineering and Mining Journal*, has the best philosophical comment that has appeared, upon the Toledo decision of Judge Ricks, respecting the boycott of the Ann Harbor Railway by the employed people on other lines, because there was a strike on the Ann Harbor Road.

Doctor Raymond's argument is that the present laws afford all required redress for malicious mischief, and the enforcement of voluntary contracts, and that if there is to be imposed obligations such as Judge Ricks' order requires, such obligations should be embodied in a contract. This is prevented by the well known fact that while the railways would no doubt willingly accept an obligation on the part of their workmen to give notice of an intention to quit work, the companies want to have the right of instantly discharging anyone from their service.

Judge Ricks' order is not confined to the rights of the public, but enters the domain of personal rights. The closing words of the order, are :

"But if you continue in that employment this court will expect "you to do your full duty to your employer and to the public, and "to observe the orders which have been made in this case."

Here it will be seen that the Court deals not only with the subject of an interference with what affects the public, but the duty to employers, a matter that courts have not much meddled with for two centuries past, and are not likely to meddle much with in the future.

At the same time the Court ordered the officers of the Locomotive Engineers Association to issue a circular to the members informing them that their regulations respecting the handling of the cars of the Ann Harbor road were suspended or rescinded, and that a copy of such circular be filed in the court.

Now the merits of all this involves a wide field of discussion and there seems to be equitable grounds for some means of restraining the men from doing more than quitting their work, that is, from inflicting an injury upon anyone by quitting service at a time that would cause loss and danger. But this is not the main point requiring discussion, it is the circumstances that rendered such an order necessary.

In the same issue of the *Railway Age* containing a copy of Judge Ricks' order, appears an article written by the Vice President of the Wabash Railway, which contains a good deal to explain the circumstances above referred to, and also the line of argument or non-argument it may be called, in respect to what is called adverse legislation. The writer cites a number of sumptuary enactments, such as requiring separate trains for white and colored people; for placing railway hospitals in the charge of State officers; compelling railways to furnish cars for shippers within twenty-four hours after a request; compelling the adoption of certain train appliances, and more.

Then comes, as argument against such legislation; the same old "building up the State" we hear so much of on this Coast. There is no mention whatever of particular abuses that have called out such regulations. The writer assumes such laws to arise from a general hostility to railways, and don't know why it exists, when the rates of carriage have been lowered, luxurious accommodations provided for passengers, the wonderful expansion of the country and so on, which no one denies, and which has nothing to do with the subject at issue. Rates are lowered by competition and nothing else, luxury is provided for the same reason. On the Isthmus of Panama one pays 58 cents a mile for tickets. Here in California we pay from 6 to 10 cents a mile wherever there is no competition, and for freight, "what the traffic will bear." There is no concession or convenience accorded that is not forced out by self interest. No policy that has any reference to public rights or convenience, and no pretence of such, except on the grand generalizations above referred to.

The open seas are placed under embargo, even lines of sailing ships are subsidized in controvention of trade. While this is being written, there are, lying in full view, three ocean steamers that have for months been swinging on their anchors, rusting away because it is cheaper for the railway to pay for interest and depreciation on these steamers than to have them competing in the coast trade. The shippers are not only taxed for the subsidy, but also an additional amount to pay for the transaction both ways.

The assumption that the public without cause have assumed a hostility to the railway interests, is only begging the question. The causes are more than sufficient to produce distrust of everything, including the decisions of courts that affect the relation of railways

to the people. and this decision of Judge Ricks' will have the good effect of directing attention to the position of locomotive engineers in respect to the laws and public rights.

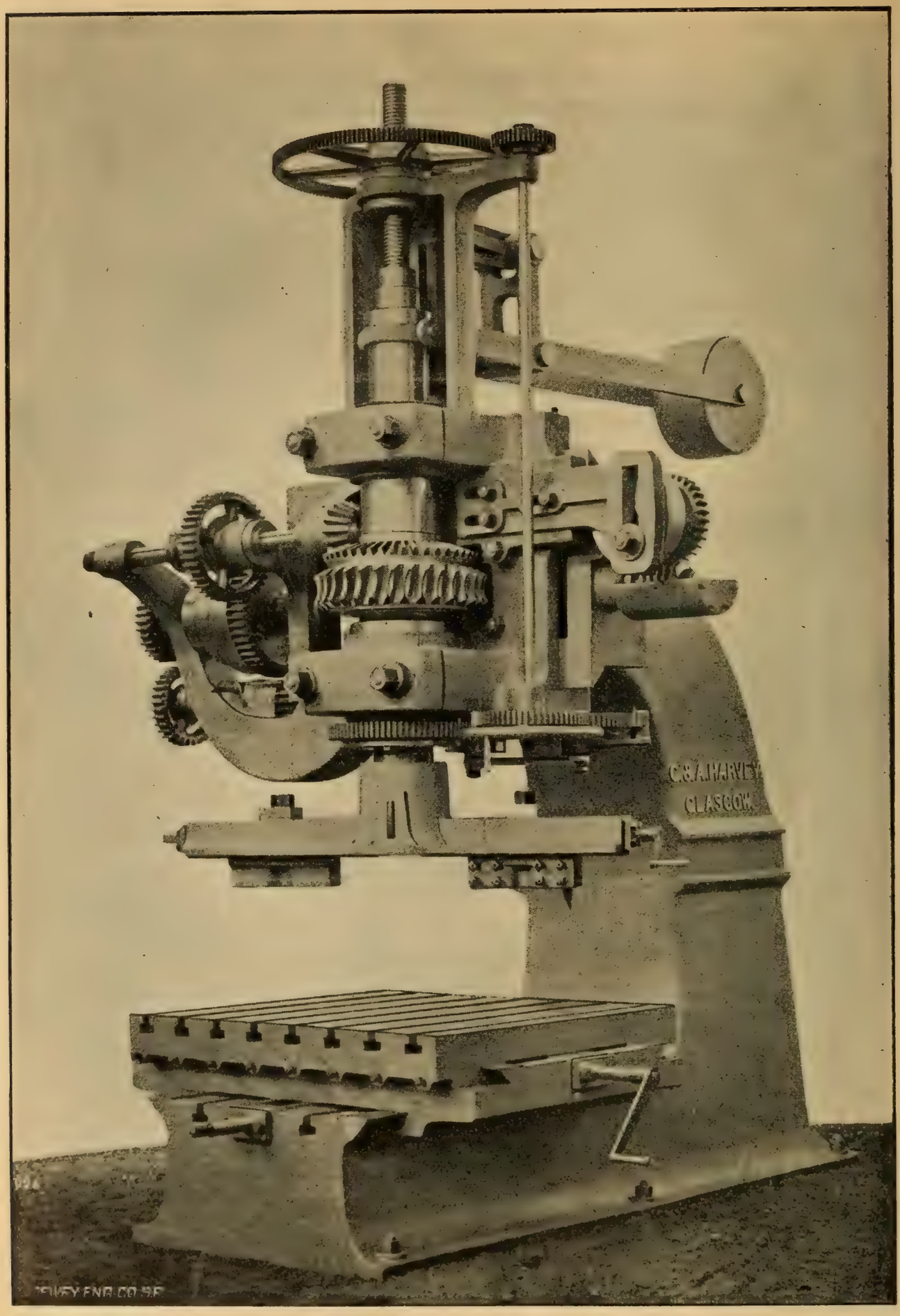
The dispute in this case involved the locomotive engineers, men who have no sanction or recognition under federal laws, although jeopardizing by a want of skill, the lives of passengers and the safety of property. Why should an engineer who is to serve on a steamer be examined and licensed, while those on railways have no such qualification or standing? It would be easy to impose, under the system that applies to marine service, such a safeguard to public interests, but it would be inconvenient, and might raise the rate of wages. There is inspection of masters, mates, pilots, engineers, boilers, hulls, and a score of regulations for the safety of passengers on vessels, but nothing of the kind for railways, not even of bridges, and the proposition to enforce some precautions to prevent killing 2,500 of their employed people each year, raises a whirl of protest.

Where we are drifting to in this matter is not clear. Railways, as well as railway engineers, need regulation. A conflict is approaching, and it will be just as well to not pile up precedents that will widen the breach and come back to plague the authors in the future.

AMERICAN SHIPPING.

Engineering, London, has just closed a series of articles on "American Industries and British Commerce," chiefly historical and "graphic statistic," that furnish interesting reading for those concerned in such matters. The subject is too extensive for a digest, and we will only quote a paragraph at the end, a kind of summing up of conclusions on the part of the writer, and will commend the views to those who think "protection" will build up foreign shipping. There is something ludicrous in one hearing in England that the safety of their commerce depends on the continuance of the protection system in America, and then having the same cause announced here as a menace to British commerce, and that the policy of that country is to break up the system here.

"It is a natural and laudable ambition of the United States to develop her merchant fleet, and we may be quite sure that to the attainment of this end much will be accomplished during the next few years. At present our geographical advantages secure for us



Elliptical Hole-Boring Machine.—G. & A. Harvey, Glasgow.

almost as a matter of course the supremacy of our merchant fleet. But when the Nicaragua Canal is completed much of that advantage will disappear, and the rich markets of the east will lie nearer to the American ports than to our own. Is not this of itself a sufficient reason to stimulate the revival of the shipbuilding industry of the United States? Americans are too practical a people to buy their vessels abroad or construct them at home without substantial prospect of permanent benefit, and we think that hereafter the last, or almost the last, official act of President Harrison will be recorded as an historical event. The close of the protectionest regime marked the commencement of a new era in American industry, a new and formidable menace to our supremacy."

ELLIPTICAL HOLE-BORING MACHINE.

MESSRS. G. & A. HARVEY, ENGINEERS, GLASGOW.

We have sent for photographs, and engraved the above machine as a typical example of machine-tool practice on the Clyde, or rather for the Clyde in Scotland, where may be seen in the ship yards there the most powerful, and at the same time the most ingenious implements that the machine-tool art has produced.

Ten or more years ago when we had the pleasure of visiting the works of Messrs. G. & A. Harvey, who make a great many of the heavy machine tools for the ship yards, we were informed that a lathe recently furnished to Messrs. Randolph and Elder, was capable of turning large propeller shafts without any expense whatever.

The firm courteously gave us a letter to the owners of the ship yard at Govan, and we called there for an explanation, and found it. The lathe was then at work, four tools acting on a shaft of 12 inches diameter, a flood of water was pouring on the tools, and the steam generated by their heat was ascending to a ventilator above. The chips cut away, when sent to the iron works as "scrap," paid for labor of attending, power consumed, interest on the investment, and for handling, so the shafts when turned should appear in the merchandise account at a lower value than when rough.

Messrs. Harvey send the following description of the machine shown in the plate:

"The machine consists of a strong main frame, or standard of box section, on the upper surface of which is securely bolted a slide or bed having planed **V**'s, and carrying cone and spur driving gear. On the front of this bed is fitted a saddle with bearings for the sleeve, through which passes the boring spindle, 8″ diameter. On this sleeve a worm and bevel wheel are securely fixed, the former

gearing into the worm on the cone shaft, the latter gearing into the bevel pinion on the end of the spur wheel shaft, motion to either driving arrangement being conveyed direct from the three-stepped cone or double gear as desired. The spindle carries a double-ended tool slide having 8½″ vertical travel, the tool boxes of which are movable horizontally for boring diameters from 3½″ to 60″. By using one tool box, and giving motion along slide to saddle by means of worm, worm wheel, disc, and connecting bars, holes may be bored varying from a complete circle to those of an elliptical form, whose transverse and conjugate diameters have not more than a difference of 7″. The spindle is counterbalanced by lever and weight, has 14″ vertical travel by hand, or self-acting feed when the double-ended slide is removed. On the upper surface of that portion of the main frame underneath the tool slide is fitted the compound table, adjustable by hand by means of screws. The upper table is furnished with bolt slots for securing the work requiring to be operated on.''

"THE DEARNESS OF CHEAP LABOR."

Mr. Daniel F. Schloss, in the *Fortnightly Review*, writes an essay under the above title. The subject is one of much interest at this time.

The law, it may be called, of an uniform labor "cost," was laid down by the Editor of this Journal eight years ago, not as a theory, but as a fact, ascertainable and necessary, under the plainest causes that support any like proposition in industrial economy. The same thing had been hinted at and put into the form of a principle of economics by a number of writers on the subject of wages, indeed, there was no way of avoiding such a conclusion by simple inferences, but no one had at the time named connected it directly with common industries and shown it as a general fact.

In Lord Brassey's "*Work and Wages*," published about 1874, there was presented some curious facts in respect to the experience of the great contractor who constructed nearly one hundred railways in various countries of the world, and who for thirty-seven years had collected statistics bearing upon this matter, all pointing to an uniformity of wages rate, in proportion to the product of the wages. This wide and indisputable proof of the uniformity of wages, and even of the advantages of high wages, somehow escaped those who were going about collecting statistics of the "rate" of wages paid in different countries without taking into account what the wages produced.

Such statistics are of but little use. One factor is left out of the problem. The collections are, in a logical or mathematical sense, absurd. As well might we look into the affairs of a mercantile firm on the basis of what they paid out each year, without setting down what was received for the money. The bare statement that a man receives thirty cents a day in Mexico or in Russia or ten cents a day in Hindostan, means nothing except that he produces an effect for which this sum pays. Wages at one dollar a day in Germany may be higher than when a workman of the same kind receives two dollars a day in this country. In fact the chances are in all cases that the higher wages are the cheapest, when general and not due to transient causes.

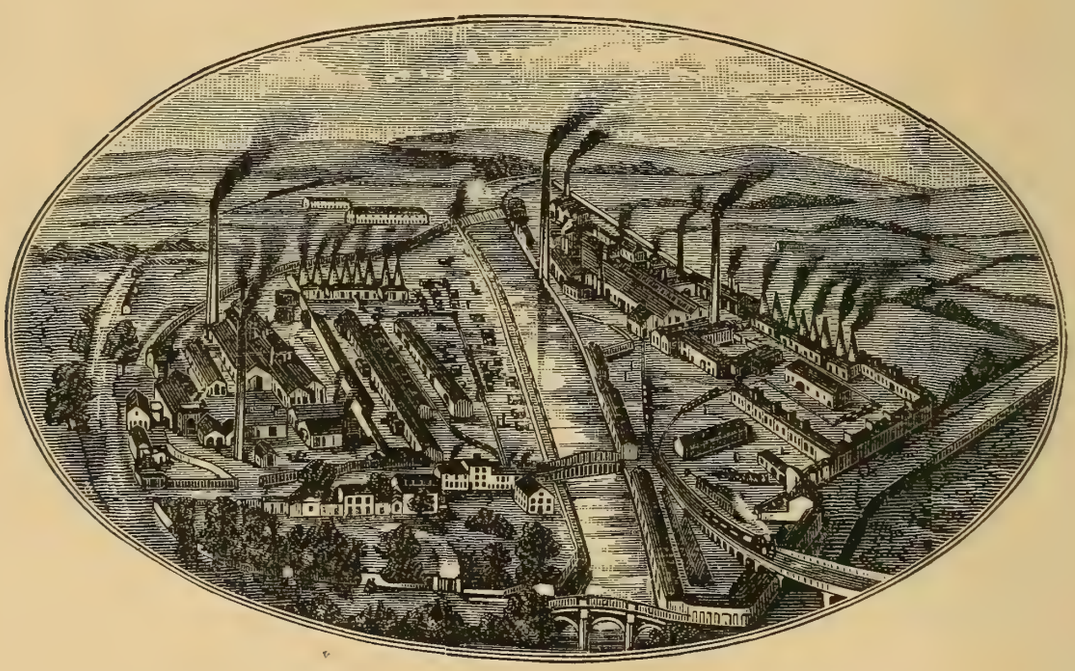
It is almost useless to refer to examples. They can be selected at random in almost any industry, and the same result will appear. Mr. Schloss in a table prepared by Dr. von Schulze, of Germany, respecting the spinning of cotton, 36 twist, shows how in South Germany, Saxony, and Switzerland, the hours of labor are 65 per week, and the cost per pound of yarn is four pfennigs, while in Lancashire, England, the hours of labor are only 55, and the cost per pound for spinning the same yarn is two and a half pfennigs. The wages paid in these countries just named, were from 18 to 21 marks per week, and in Lancashire, England, from 38 to 40 marks. In other words the cost of spinning a given quantity of yarn is 40 per cent. less in England, where the wages are more than double as much, for ten per cent. less hours of labor.

The labor cost of steel rails is in this country about 17 per cent. less than in England, where wages are not more than half as much in this industry. This statement is from Mr. Schoenhoff, who made up carefully the cost of producing steel rails at two places in England and in some of the American mills. How the cost was arrived at in this country it is hard to see, because, as noted last month, only one firm or company among all applied to, furnished the congressional committee of inquiry with information as to the labor cost of steel rails in the establishments applied to.

This being the "law of wages," to so call it, no argument is needed to show that when the amount of wages paid is greater than their product, industry must cease. This is the only rational argument that can be advanced that will avail against strikes and extortion on the part of workmen. In this country most people have been busy for five or six years past in convincing workmen that wages were higher in this country by reason of a tariff and inflated

prices. The workmen took the hint and have demanded their share of this inflation.

The theory was that if the rate of wages was a thing to be regulated by law or increased by law, why fix a limit? and why not saddle on the consumer an increased cost of commodities, and pay it out by an increase in wages. It is a pernicious doctrine, this one of high wages in one country and low wages in another country. It is not true, and as before said no theory or explanation will meet and disarm labor disturbance so quick as an understanding that wages are not an accident, but a fixed quantity for a given product, and of necessity the same, or nearly the same, in all countries. Mr. Schloss has added a good deal to establish this truth.



STEEL WORKS OF MESSRS. WM. JESSOP & SONS.

SHEFFIELD, ENGLAND.

In our issue of last month was given some of the particulars in the early history of cast steel making in England, and in the present number we will continue the subject by some notice of the immense establishment of Messrs. Jessop & Sons, steel makers, at Sheffield, England. The works, shown in the engraving above, cover thirty acres of ground, and do not comprise the whole of the plant of Messrs. Jessop & Sons. The pen steel, that is, thin steel from which steel pens are made, is produced at a separate establishment.

There is, besides, another, which we have not visited, the purpose of which is not remembered.

The firm of Messrs. William Jessop & Sons was established in 1793, and the business is now a century old. Its history is full of useful lessons to our newer efforts in this country. Their success is an outcome of good faith and honest manufacture, with a careful attention to small things as well as great. The firm have always sold a large share of their product in this country, and their attention to a remote agency was just the same, in so far as promptness and thoroughness, as that given to the London branch, as the following circumstance will show.

The Ohio Tool Company, at Columbus, Ohio, founded about 1844 for the manufacture of edge tools, planes, and so on, used Jessop steel for their manufactures. The steel laid on plane irons was of No. 16 to 14 gauge, the thickest not exceeding one sixteenth of an inch. This steel was "roll welded" on the iron plates, and did not receive the hammering that other tools did, such as were forged out to shape. There was some difficulty in tempering, and a letter or letters were written to the agents at Boston, who could not explain the matter, but said it had been referred to Sheffield. Some time after the Ohio Tool Company were astonished at a visit from a member of the firm at Sheffield, who had come out to see what was wrong. He returned to Sheffield, and prepared the thin steel to suit the processes of working, which have gone on ever since without difficulty.

The firm have agents all over the world. They purchased a building in New York, at 91 John St., fifty years ago, which has remained the head office in this country ever since, Mr. William Wagner being the general manager there. Of late years the firm or company, it is now, like others in the steel business, have added steel casting as a branch of their business, and make all kinds of cast pieces up to the largest.

The business has remained in the Jessop family since it was founded in 1793 by William Jessop, who was succeeded at his death by his three sons, Thomas, Sydney and Henry Jessop. Later on, at the death of Sydney Jessop, Thomas became sole owner until the business was organized as a corporate company. Thomas Jessop died at 84 years of age, and his son William Jessop, grandson of the founder, is now chairman, or, as we would call it in this country, president of the company.

Among the great steel makers this firm is, no doubt, the best

known of any in the world, and its history as an achievement more deserving than that of some very famous people who have done much less in building up the greatness of their country. There is something in an industrial firm 100 years old more attractive and deserving than in distinctions earned with less risk and labor, especially as in this case where the increment of wealth and volume come in the form of moderate profits made from year to year like natural growth, instead of from speculative schemes over-reaching other interests.

TECHNICAL SOCIETY OF THE PACIFIC COAST.

This association held their regular meeting for April, at their rooms, 819 Market Street. The paper of the evening being one contributed by Professor Chas. D. Marx, of the Stanford University, on "Some Problems in Municipal Engineering." This paper is reproduced in the present issue, but not the discussion thereon, for want of space. This paper we think could be profitably supplemented by another from the same author, in which would be explained the municipal affairs of some modern cities: Berlin, for example; also Glasgow and Birmingham in England, and Detroit in this country.

The following new members were elected:

Thomas H. Leggett, Mining Engineer.....Bodie, Cal.
P. E. Lear, Electrical Engineer.....San Francisco, Cal.
John J. Williams, Topographer (Junior).....Berkeley, Cal.

Three new names were presented for membership.

Mr. Adolph Sutro, honorary member of the Society, tendered an invitation for the members, or such as would attend, to visit Sutro Heights sometime during the present or next month, to examine the improvements and extensions of the past year, and to be entertained at a luncheon to be served at his residence.

Mr. Sutro takes a warm interest in the Society. Its aims and work are congenial, and his future plans, if carried out, will involve a good deal in which the Society may render him some aid in the munificent enterprises in which he is engaged. His own experience in technical matters has well served an important purpose, and has led to success in all that has been attempted.

At the next regular meeting, May 5th, two papers will be read; one on "Electric Transmission," by Mr. W. H. C. Hasson, and an essay on "Photographic Topography," by Mr. Ernest McCullough.

NOTES ON NEW AND PATENTED INVENTIONS.*

BY J. RICHARDS, IN CASSIER'S MAGAZINE

No. IV.

COMPRESSION COUPLINGS.

Coming now to interchangeable couplings, these all belong in a class that may be called compression, that is, capable of being clamped on the shafts to secure a fit, and be loosened by means of screws, wedges or other devices. Such couplings we will speak of under the general head of compression ones, and give some examples to show the various expedients that have been adopted to clamp them on the shafts.

Compression couplings, while they seem to be divided into two classes: one with conical collars, tapering wedges or screws that act indirectly, and the other class, plain clamps that act directly by means of bolts or screws. If examined, however, it will be seen that in all couplings of either kind the method of compression is based upon flexure. There is, indeed, no means of reducing the bore of a coupling, or anything else made of iron, except by either flexure or condensation of the material.

This may seem a bold proposition in view of the fact that not only in couplings but in many other cases, such as compensating bearings for shafts or spindles, we find devices for concentrically reducing the bore of holes, but if any or all of these contrivances are analyzed it will be found that no such reduction of bore can take place without flexure, and in the case of conical collars without the metal being condensed or "upset."

Another principle involved in all adjusting conical devices, is that adjustment in the plane of the bearing or running faces can do no good, in other words, adjustment parallel to any face causes no change normal to that face. It is true that many such adjustments are provided for clamping and for compensation in bearings, and seem to answer such a purpose, but this claim is only a compliment to good fitting, the fact being that adjustment is not required. This is certainly the case with the spindles of machine tools, because any attempt to adjust a conical bush diag-

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onal to its exterior face must lead to distortion, and a bad fit that would show itself in milling machines and lathes where such bearings are usually found.

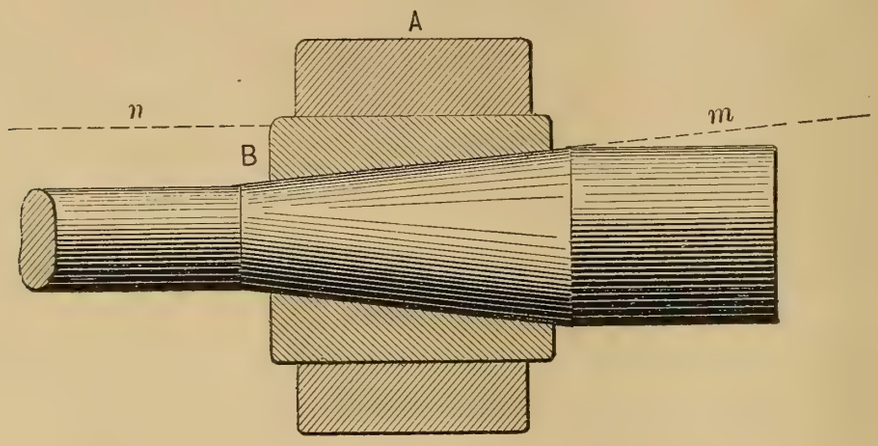


FIG. 5.

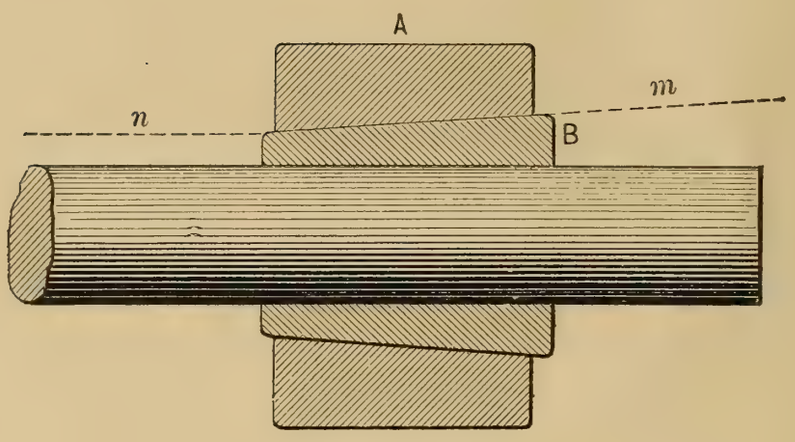


FIG. 6.

In considering this subject of compressing or clamping devices by means of tapers or cones, it is important for those who have not previously examined the subject that this matter of adjustment should be made plain before referring to the particular devices. Figures 5 and 6 are prepared for such explanation. Suppose that *B* and *B* are conical bushes, one tapered on the inside as in Fig. 5, the other tapered on the outside as in Fig. 6, and that the adjustment in Fig. 5 is on the line *n*, and in Fig. 6 on the line *m*.

The construction in Fig. 5 is common in various kinds of machinery in Europe, and to some extent employed in this country for lathe spindles and the like. That in Fig. 6 is common in this country, but, so far as known, is not employed elsewhere. The two things seem analogous at first sight, but they are not so. Adjustment in Fig. 5 is on the line *n*, diagonal to the running faces, consequently these approach or leave each other parallel as the bush *B*

is moved backward or forward in the stationary part *A*, forming a complete annular adjustment.

In Fig. 6 adjustment is also on the line *n* the same as before, but is parallel to the shaft and the running faces, consequently can have no effect on these faces without condensing or compressing the bush itself. It will also be seen that as this adjustment is diagonal to the outer faces of the bush on the line *m*, consequently it is not possible, because movement endwise cannot take place, unless, as before remarked, the bush is condensed.

If the bush is split it may be closed in a slight degree, but not concentrically, because there is no fit except in one position. It is bad construction in any case, when directed to a reduction of bore, unless the bush is made of some soft alloy that can be compressed so as to change its shape. We have treated this matter at some length, because it is a method common in compression couplings, and its limitations not well understood. It is not contended that there is no compensation or adjustment of such devices, but that it is infinitesimal without destroying the fit.

There is, in some cases, a successful application of this conical bush method of clamping by cutting away the exterior of the cone so it will bear on narrow faces only, as in Figures 7 and 8, taken from a clamping spindle chuck made by a firm of machine-tool makers at Manchester, England.

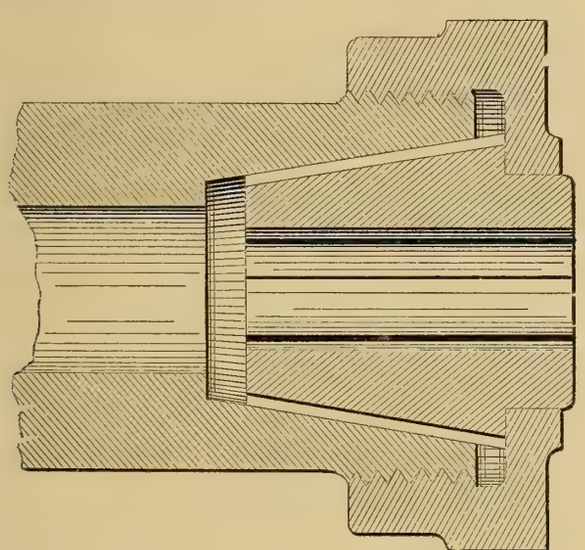


FIG. 7.

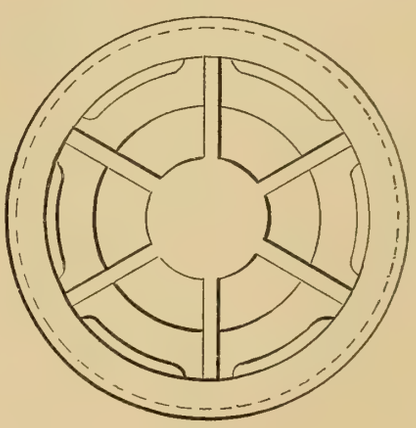


FIG. 8.

Fig. 7 is a longitudinal section, and Fig. 8 an end view with the screw collar removed. The conical member is split into six parts, and the exterior cut away so the bearing is on twelve narrow ledges that by reason of the small area in contact can be adjusted in the

socket. The drawing is made from memory, and may not be correct in all respects.

Another example of successful clamping in the same manner is shown in Figures 9 and 10.

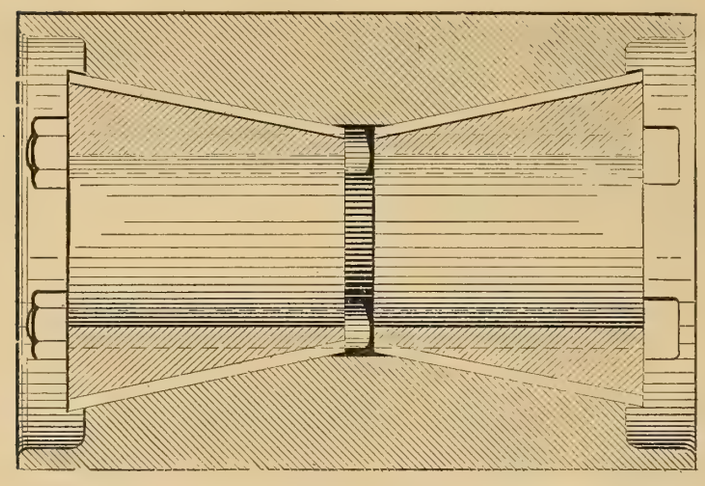


FIG. 9.

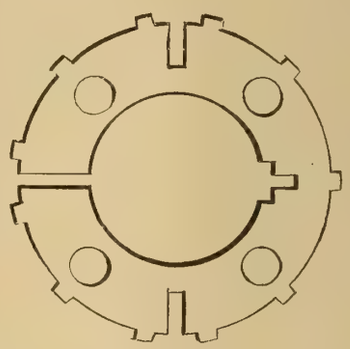


FIG. 10.

Fig. 9 is a section through a shaft coupling designed by the writer in 1885. Fig. 10 is an end view of one of the cones. The drawing is taken from a coupling of 2½-inch bore, and the bearing ledges on the cone were about ⅜ inches wide, eleven in number, the cone being slit through at one point and partially cut through at three other points, as shown in Fig. 10. This, as will be seen, is the same thing as the chuck just described, and the range of compression, without distortion or bad running, was a good deal increased over cones that had a bearing all over their outer surface.

The limit in this direction, however, was not in the exterior of the cone, but the interior bearing on the shaft. If the cone had been split into four parts it would have closed on the shaft at four or eight bearing points as the fit was close or loose, but as made, the fit on the shaft was defective when the size of the latter was varied from the standard size for which the couplings were bored.

The coupling shown in Fig. 11 was also designed by the writer in 1866, at a time this subject of cone adjustment came up as a problem in the works. The theory was, that a thin shell or sleeve around the shaft when split open on one side would close concentrically, and fit on shafts that varied so much as is common in turning and finishing them. The drawing is from a coupling of 2½-inch bore, the sleeve being $\frac{3}{16}$ inches thick at the ends, and $\frac{7}{16}$ inches at the middle.

The conjecture respecting concentric action of the shell was correct for a limited amount of adjustment, but, as in all cases of screw and wedge action, the friction of the screw collar prevented the couplings being drawn up with a common spanner, but by driving

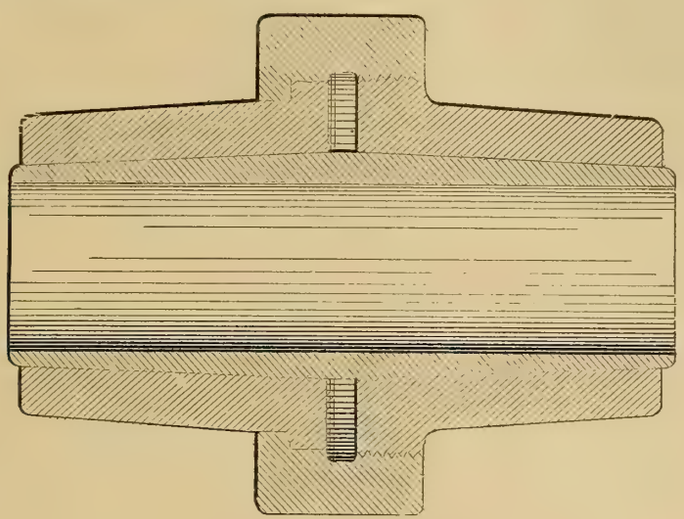


FIG. 11.

on the outer shells with a maul or hammer the couplings could be made so fast that no keys were required in ordinary use.

These couplings were made both in this country and Europe, perhaps are yet. Their history is not known, but the accuracy of the work required in making them has, no doubt, prevented successful competition with cheaper modifications.

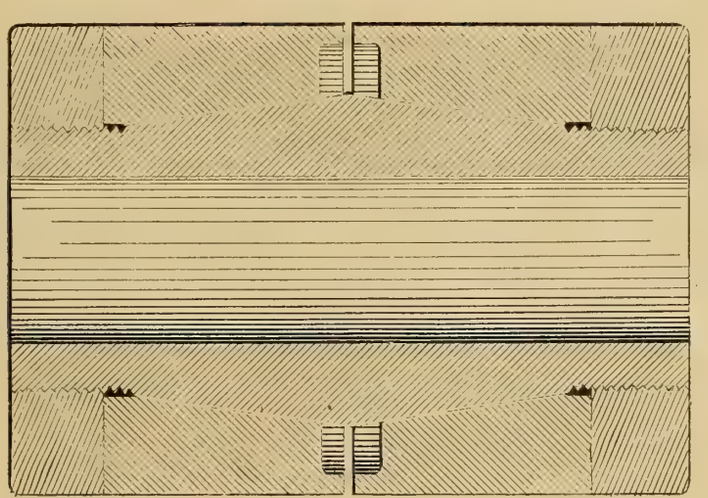


FIG. 12.

Fig. 12 represents a coupling the name of which cannot now be recalled. It is included here to explain some features of design peculiar to all mechanism for "connecting" as well as shaft couplings.

It was pointed out at the beginning that the functions of a coupling were to impart a rigidity equal to that of the shafts connected, and to transmit torsional strain equal to the strength of the shafts. To these can be added another rule, that the compression or gripping strain should be enough to prevent movement in the sockets or bore, and a third rule, that all these three functions should be performed by the same members, that is, the same metal employed to secure rigidity should perform the office of compression, otherwise the size and weight of a coupling will be increased in proportion as these functions are independently performed.

Fig. 12 is introduced to illustrate this matter. The transverse strength of the coupling, or its rigidity, is represented in this case by the cross section of the inner shell or sleeve at the middle, where the coupling is nearly cut in two. It will also be seen that the function of compression or fit is performed by the inner pair of rings or collars, and that these have no other office; also that the ring nuts at the end have no function except to press the inner rings on the conical faces of the sleeve.

Applying the rules before named, their truth will be apparent in dimensions of this coupling. It is a cylinder having a diameter at least three times that of the coupled shaft, if made of cast iron, and its weight double that of any coupling in which rigidity, compression and torsion are all provided for in the same members.

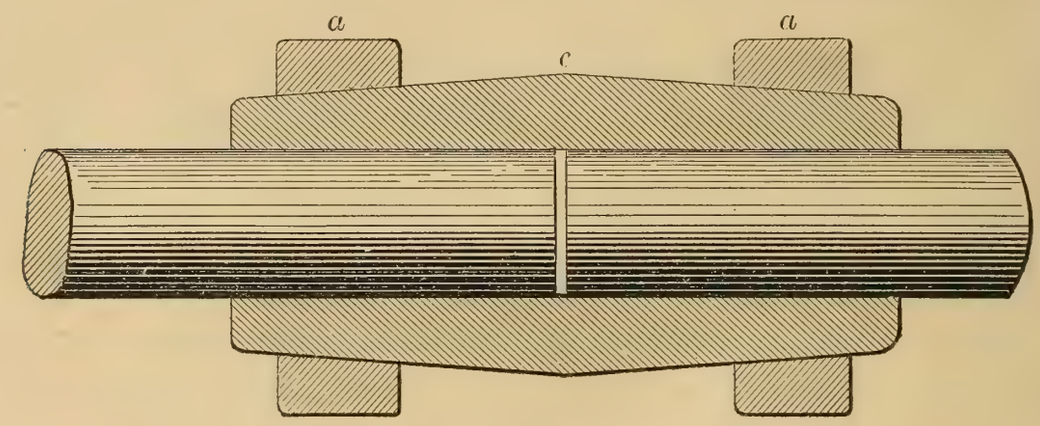


FIG. 13.

Very good couplings of minimum weight have been made on the same principle as shown in Fig. 13, where the member in compression *e* is of cast iron, and the members in tension *a a*, are of wrought iron. The main shell *e* is in two parts, and the rings *a a* are driven on the tapering ends. Comparing, it will be seen that the two collars *a a* represent or perform the same functions as the four do in Fig. 12, and those in Fig. 13 being of wrought iron, their section

can be reduced to one third or less than one pair of those in Fig. 12, or, in other words, the outer or enveloping members are, in practice, not more than one sixth as heavy.

The couplings shown in Fig. 13, so far as we know, were first made by J. H. Cooper, of Philadelphia, and, aside from requiring to be driven on by blows, are among the best of their class. It is true the inner shell has to be heavy to furnish the required rigidity, consequently is not capable of much flexure, but the same remark applies to nearly all kinds of compression couplings, namely: they require that the coupled shafts be of accurate diameter in order to hold safely.

Almost any compression coupling can be strained to clamp a shaft slightly under size, but the surfaces will not fit, and deflection of the shafts from the strain of wheels or belts, or being out of line, will soon produce abrasive wear in the sockets, and failure. The fact is, that compression couplings to fit shafts that vary in size are a myth, except within very narrow limits not exceeding .005 of an inch. Of this, however, more will be said in the end.

Conical screws, wedges and the various devices for compression, within solid shells that bear the reaction of the clamping force, are all amenable to the conditions pointed out, unless it be in the case of screws, which by reason of their helical exterior or bearing faces, can be adjusted to a greater degree than the smooth faces of wedges or cones.

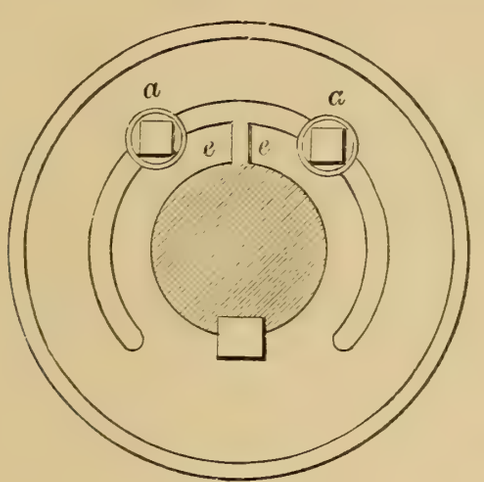


FIG. 14.

Fig. 14 is a diagram, drawn from memory, of a compression coupling that has been extensively used, and seems to have filled the required conditions of such couplings very well. Compression is derived from flexure of the two members *e e*, these being forced in upon the shaft by two tapering screws *a a*, made with a fine thread

and tapped into the slot as shown. The members *e e* are severed at the middle of the coupling to permit independent action on each shaft. These close on the shaft in some degree concentrically, over one half of the shaft's circumference, but it is obvious that a fit is required, otherwise the coupling would soon wear out in the sockets if there is deflection of the shafts.

CLAMP COUPLINGS.

The class we have termed clamp couplings embraces quite a range of modifications, all practically the same in effect and nature, or nearly so, and are, no doubt, the best as well as the most simple that can be applied in an interchangeable system. As pointed out before, the function of closing or the reduction of bore in all devices of the kind is due to flexure, and in the clamping class of couplings the closing force not only performs the office of compression, but also produces, in a direct manner, the flexure required for closing or reducing the bore.

This can be illustrated by Figures 15 and 16, which are side and end views of one of the oldest forms of clamp couplings. These

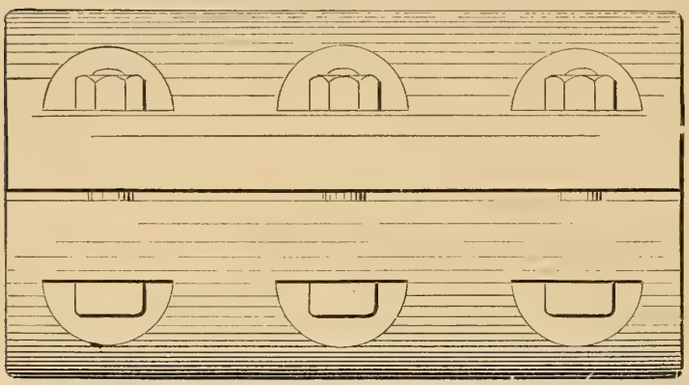


FIG. 15.

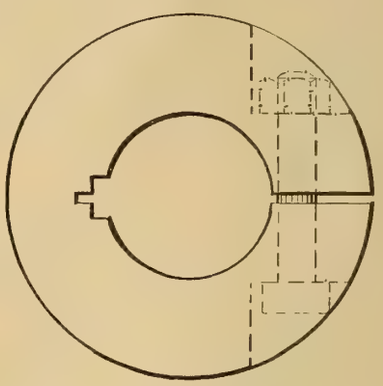


FIG. 16.

were employed by Mr. Robert Briggs, of Philadelphia, a well known engineer, who died about twenty years ago. They can be seen in substantially the same form in the works of Cail & Co., Paris, the celebrated locomotive builders there. In this latter case they were made not less than thirty years ago, and most likely more than forty years ago, because in 1870 when we visited these works no one seemed to know how long it was since some of the older lines of shafting were connected in this manner.

These couplings are cheap, and when the shafts are carefully turned hold remarkably well, but it is obvious that if strained down upon shafts under size there is danger of fracture at the fulcrum of

flexure opposite the slot. There is also the objection common to all couplings noticed this far, that they can not be removed and replaced without taking down or moving the shafts, and are not balanced in the distribution of the metal.

The exterior contour is free from projections that cause danger, but the clamping screws, countersunk as shown, cannot be turned with a common key, and require a socket one. These couplings have not survived, probably because their merits are not known, but more likely because they do not seem ingenious and complicated enough to meet common opinion.

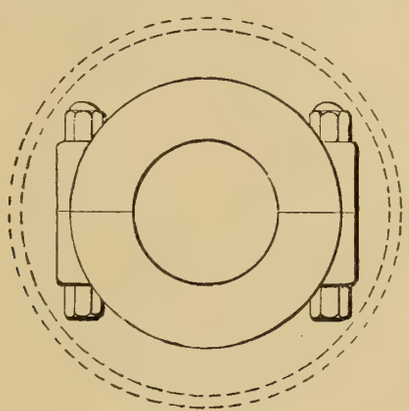


FIG. 17.

Fig. 17 is an end view of the plainest form for clamp couplings, and the first modification among all the compression class this far referred to that can be removed and replaced without disturbing the shafts connected.

It will seem in controversion of history and common practice to claim that a coupling of this kind, in addition to the advantage first pointed out, is the best that has been devised, and comes nearest fulfilling the desired functions for devices of the kind, but such a view is in accordance with the facts. Clamp couplings were the first, and no doubt will be the last among devices of the kind.

The clamping bolts, in addition to expending their force directly in compressing, also tend as directly to bend the shell, and close it concentrically around the shafts, such action being perfect up to such limits as the metal will bear, and for any kind of malleable metal far beyond the irregularities of size that occur in fair turning.

One proof of the strength and reliability of couplings of the kind is that they are provided to connect broken propeller shafts at sea and successfully perform that purpose. A propeller shaft can be compared to an engine shaft from 50 to 150 feet long with a flywheel on the extreme end, and the enormous strains endured are indicated

by the number of fractures that occur. The selection of plain clamps to connect broken shafts of the kind is strong evidence of strength, reliability and facility of application.

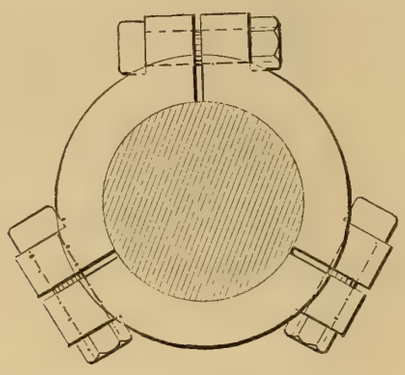


FIG. 18.

Such clamps when divided into three parts, as shown in Fig. 18, are still better, giving as we may say, nine points of impingement at the center and each end of the arcs in contact. It would be an interesting and useful problem to resolve the compression strains in this case with certain assumed proportions. This will be done in a future place.

In some cases these clamp couplings have been housed or covered with a shell, as indicated by the dotted lines in Fig. 16. This, while it makes up a symmetrical device, is expensive, and moreover destroys one function, that of removal from the shafts in place, because the covering shell has to be made in one piece.

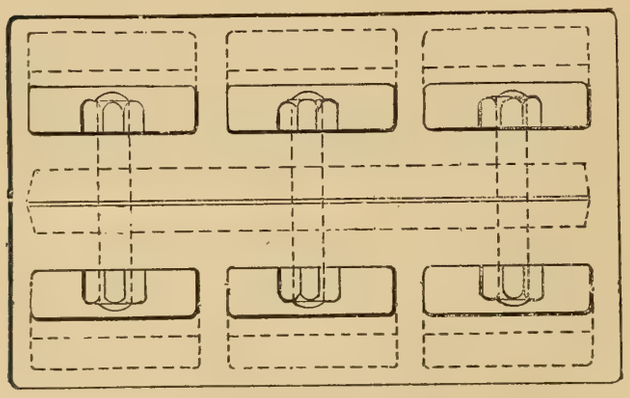


FIG. 19.

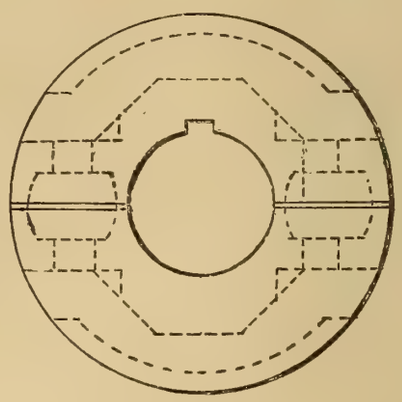


FIG. 20.

If a covering shell is made integrally with the main one, as in Figures 19 and 20, the two shells being connected by flanges or diaphragms between the bolts, as shown in Fig. 20, there will be, with one exception, all the required functions that have been pointed out, with the least possible amount of metal.

These functions we will repeat as follows : (1) to secure continued rigidity of the shafts through the coupled shafts ; (2) to have a torsional resistance superior to the shafts connected ; (3) a smooth contour to prevent danger of catching or winding belts or clothing ; (4) to close for compression concentrically ; (5) to be removable without taking the shaft down. To these conditions may be added some others of less importance, such as an avoidance of jamming or rusting fast ; admitting of the use of common wrenches to fasten or loosen the screws ; the exterior adapted for use as a pulley for belts.

All these conditions are fulfilled by the clamp coupling shown in Figures 19 and 20, except the clause No. 4 relating to flexure. A double shell, connected as shown, becomes very rigid, and the two halves close on the shafts as two semicircles. There is, however, flexure enough to meet ordinary requirements, because, in some experiments made in England in 1886, where examples of nearly all forms of compression couplings then known were tried, the present one showed the greatest truth and endurance when applied to shafts varying in diameter, and sprung out of truth until the couplings failed. Fig. 21 is a perspective view of one of these couplings as it appears when applied on a shaft.

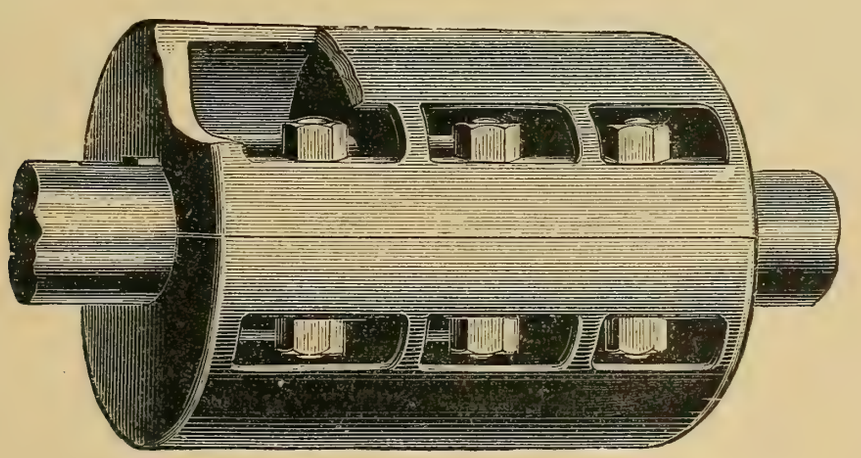


FIG. 21.

In this review of compression or interchangeable couplings, the purpose has been to select types and analyze the conditions or functions that pertain to them on commercial as well as mechanical grounds. Computations in respect to couplings, cover but a limited field, and are confined mainly to proportions for resisting torsional strain and flexure, but these are not in practice, the principal facts to be dealt with. Failure comes in most cases from abrasion in the sockets or bearings for the shafts. A small amount of movement

takes place because of a bad fit, or insufficient gripping power, and abrasion begins, ending with what is not inaptly called "chawing out the hole."

The primary cause of failure is want of alignment, or flexure from other cause, such as the strain of belts or wheels that causes a slight movement in the sockets. Abrasion begins, and goes on in an increasing degree, until the end comes.

New inventions have not been reverted to or considered in this section on shaft couplings, because there has really been no recent progress in the art. The first interchangeable couplings made, the plain clamps, were among the best. Those with conical shells and bolts, invented and introduced by Messrs. William Sellers & Co., of Philadelphia, thirty or more years ago, and yet extensively made by this celebrated firm, are among the most complete that have ever been produced, and were the outcome of a successful attempt to reduce shaft fittings to an organized manufacture.

The principal difficulty met with in the system has been the mistaken opinion that such couplings were to fit on shafts varying in diameter, which, as at first stated, is a myth. Their object is to permit organized or duplicate manufacture of shaft fittings, and to facilitate putting on and removing the couplings from shafts. Without this there can be no systematic manufacture of the kind, and to compare interchangeable or compression couplings with keyed-on flanges is to admit a lack of understanding the subject. There is a place for both methods, but not on line shafting as now produced and sold in this country.

HEAT IN OIL ENGINES.

THE PRIESTMAN ENGINE.

Mr. William L. Saunders, in a lecture before the Franklin Institute, Philadelphia, last year, called attention to a fact in respect to the use of compressed air that is curious and true. We commonly look upon the heat generated in compressing air as a misfortune, a malefactor, so to speak, but Mr. Saunders points out that the heat generated in compressing air is the active element, and if the heat could be combined with the air without compressing the latter the result would be the same.

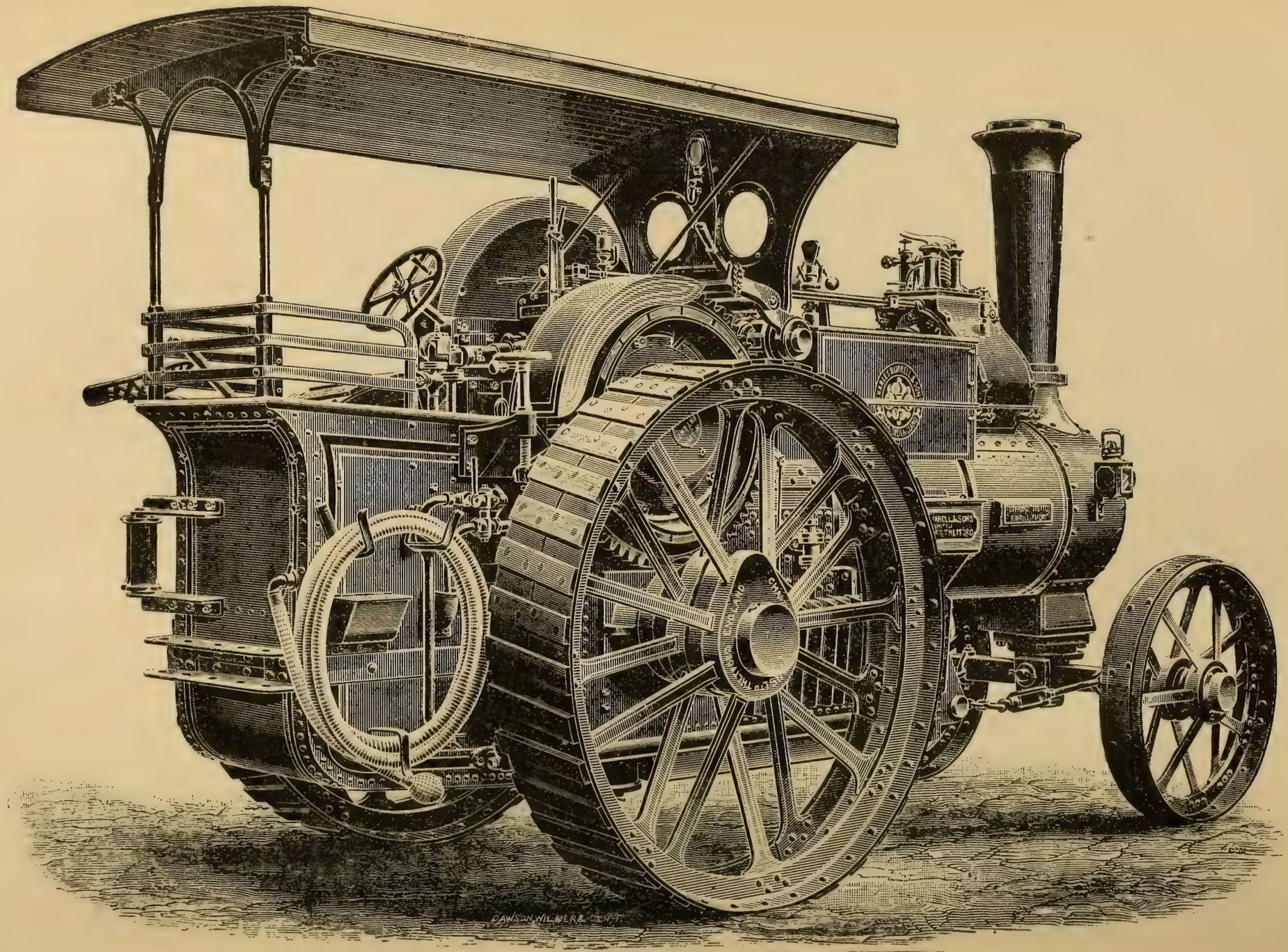
The subject came up in connection with a description of the Priestman oil engine, given by Dr. Coleman Sellers, before the Franklin Institute in December last, and was employed to illustrate the method upon which the Priestman engine operates.

The fuel for these engines is petroleum oil, such as is burned in lamps, not inflammable, and is not mixed with air in the sense of becoming volatile. It is atomized in the air to make an explosive mixture, but is only mechanically combined therewith, because it will separate from the air in an instant if the charge is left in a state of rest. In this manner there is no danger of explosion, because nothing is inflammable except the charge in the cylinder, and that only during compression, or while the sprayed oil is in suspension. Mr. Sellers' paper closes with some letters of recommendation from people using the Priestman oil engine, that are pretty fair advertising.

The Priestman engine has been designed anew in this country to correspond with Professor Sweet's Straight Line steam engines, and has the important advantage of relieving the cranks from the violent impulse given by the explosion.

While this engine has been the subject of much study and experiment, and ranks high among established motors of the internal combustion kind, we doubt if it will be able to contend commercially with those that employ volatile fuel or gas. An air compressing pump and an atomizing apparatus, which are required for heavy oils, add a good many details, and these of sensitive kind liable to derangement.

The maintenance of a reservoir of compressed air is of itself a difficult matter, involving carefully-fitted parts, and the minute orifices required to spray the oil must also cause some difficulty to maintain, so that on the whole the more simple form of these engines, such as volatilize the oil by heat or use carburetting apparatus, are likely to lead, for the present at least.



English Traction Engine.

ROAD LOCOMOTIVES AND TRACTION ENGINES.

There seems to be some peculiar impediment in the application of steam engines to road locomotion. The art has had lavished upon it a great amount of ingenuity and skill without corresponding results, and if one sets out to seek the generic causes of failure or difficulty they are by no means plain.

The impediments to be overcome are of two kinds, operative and constructive, these are in a sense distinct, although common opinion construes the failure of steam traction on common roads to the constructive part of the problem, which is wrong. It may be assumed that adaptation to purpose is a part of successful construction, but there are limitations set up in many cases beyond which human ingenuity cannot go. This is the case with road locomotives and traction engines at this time.

Referring first to the operating conditions, such engines have to carry a supply of water and fuel, and as this dead load must be multiplied by the resistances, which are, perhaps, five times as much as when a similar weight is conveyed on rails, this resistance forms one impediment, and a considerable one in an economic way.

The supply of fuel and water is a still greater difficulty, and, perhaps, the principal one of all. The difference between a railway and a roadway in this respect can be imagined by supposing that each railway locomotive were to require separate fuel and water stations for its supply, and not only that, but such stations were not in the course of travel, but must either be hauled about, or else special trips made to procure fuel or water. Each traction engine, or each owner of traction engines, must supply his own plant, so to call it, for providing fuel and water, and there seems no way out of this expensive difficulty unless it may some time come in the way of stations on the principal highways where passing engines can be served.

This impediment in the concrete becomes cost of driving power, or so much per horse power maintained, and it will average not far from four times as much as in the case of railway locomotives or stationary engines, and when we consider that the power thus expensively derived must be again multiplied by four for quantity required, it lowers commercial efficiency to one in sixteen compared to a common railway.

This waste and cost of power in moving loads over the ground, or on common roads, is, however, not the only difficulty that traction engines have to deal with. Their running gearing is exposed to mud and mire, and subject to contorsions that calls for the strongest material lavishly employed, and a flexure of joints and attachments that taxes mechanical ingenuity. The fact is that this problem is one of the most difficult that has ever been essayed, and the end is by no means clear at this time.

We must naturally look for the earliest success in road service in the older countries that have good roads. The progress in England has been a good deal, and we have engraved what seems to be one of the latest type of traction engines in that country, shown in the plate on page 334. It is a massive and expensive machine, varying somewhat, but not a great deal, from the Fowler engines imported for use in the San Joaquin Valley here.

This Coast will, no doubt, be the principal field for the development of traction engines in this country, not because the circumstances demand or favor such machinery more than the western and southwestern states, but because such innovations are sooner entered upon and pursued. Several firms have engaged in the making of engines for farm use to supplant horses, especially in propelling the immense combined harvesting and threshing machines employed here, a service that is very destructive to horses, because of the heat and dust. Also for ploughing, because a traction engine cannot well be maintained for a single kind of duty.

In this City Mr. Byron Jackson has been experimenting for some time on this problem of steam traction, and has added a good deal in the way of adaptation to purpose, control of course, and in the economy of fuel, but has naturally met with such varied circumstances of use as to render the manufacture one of exceeding difficulty. In the alluvial lands the dead vegetable growth, fibrous and tough as hemp, clogs the plows and machinery, and when engines are provided with power enough to propel them against various resistances the power becomes enough to slip the wheels, and the engine "buries itself," as the farmers term it. The driving wheels, especially when provided with claw plates as shown in the drawing, will cut down into the earth like a circular saw.

We hope at some future time to give some further account of Mr. Jackson's experience and views, the present mention being without his information, or definite knowledge of his experiments.

A TARIFF ON COTTON.

One finds in the journals of the day some queer views on economical subjects. In a recent issue of a contemporary there is an article commending a tariff on cotton, or at least citing the growth of opinion in the cotton states in favor of such a tax. The buyers of cotton would hold to a different view. All want a tariff on what they have to sell, and free trade for what they buy. It is a most flexible doctrine, but follows closely on the line of personal interests.

Those loudest in their demands for a tariff on their product, are the striking workmen, who are denounced in one line, and a tariff on commodities praised in the next line, yet it will be hard to point out a distinction, the workmen want an enhanced price for their product, that is, labor, but cannot secure laws to enforce such increased rate, and instead combine, strike and "boycott." The producer of commodities is more fortunate, or thinks so, in securing laws that raise the price of his goods, but generally he is mistaken as to measure if not as to fact, because not much of the increase remains in his hands. It follows back to material and expense, also to labor, and on to the consumers, who are the manufacturers and their neighbors.

The only rational view that one can arrive at is to class together all that acts in controversion of trade, such as trusts, combines, strikes, tariff, and the rest. It is "all of a piece;" one principle tending to a like result in the end, and no one to be consistent should complain of a tariff on cotton, or anything else, if prices are to be thus regulated.

The cotton industry is one that has been stable, and has flourished in this country, while the wages paid for spinning and weaving have been no more than in England, because we had the material at the same price as other countries. The same thing is true of the leather industry, for which hides could be bought at their price in the open markets of the world. Wool, on the contrary, has been protected and inflated, and we need not remark upon that industry. Its history here, in California, will do for an example. When it was proposed, four years ago, to put a tax on hides, the New England people raised a vigorous protest, and defeated the scheme, and for good reasons, the very same that now apply to a tax on raw cotton, only the latter would affect a more extensive interest than the manufactures of leather.

Soon one may look in vain to find any industry, calling, or even a profession, not seeking an advantage over others by sumptuary laws, combinations, strikes, tariffs, franchises, or special privileges of some kind. Opposed to this is true patriotism, a regard for the country as a whole, fair play and equal rights, also a confidence in our powers and manhood as a nation, instead of a cringing fear of others.

We need no tariff on cotton, wood, iron, timber, or anything else that enters largely as material into our industries, but, instead, want confidence in our power and resources to compete with any and all in the industrial race. Wages may rise when the price of material falls. The two things cannot rise together unless our products are shut out of the world's markets by enhanced prices.

There is still another view of this matter of a tariff on cotton, or anything else, produced in certain sections of the country. The boast has been that we have absolutely free commerce between the states of the Union. This is remarked on frequently by people of other countries, and accepted generally as a fundamental fact of our system, but is it true? If so why should the iron industries of this Coast petition for the removal of the tax on iron, steel, and the elements entering into iron production? The iron comes mainly from Pennsylvania, and if there is free commerce between California and Pennsylvania, why should there be cause for protest? There is no truth in this assumption of free interstate commerce except in name.

Each state, like firms, companies and combinations, strives to secure a duty on its principal product, not against foreign customers, because a tariff tax does not affect them, but against other states and our own people. California wants a tax on fruit, timber, quicksilver, borax and wool; Pennsylvania wants a similar tax on iron, coal and glass. The cotton states want a tax on their product; Louisiana on sugar, and so on to the end. Wherever a commodity is generally produced there is no clamor for a tax upon it. Farm products, such as are generally grown all over the country, have no tax, or if there is one it has no effect, so it narrows down to the principle of exclusion, and is really a family matter between the states of the Union.

The only fair tariff in any country is one assessed upon what is "not produced." This becomes a plain obvious tax without discrimination between the people. No state or section would have any right to complain of such a tax if all bore it equally. As to fostering industry by enhanced prices, those who have given this

matter the most attention believe the effect to be just the opposite.

There is no part of the world, however remote, where the natural resources are not sought out and used. The incentives of gain are the strongest that exist, and there is no climate, or barrier of any kind, that will prevent the development of industry invited by natural facilities, but artificial prices are a hindrance instead of an aid. The frigid fields beyond the Arctic Circle are explored for minerals, pelts and fish. The hot and poisonous fens of the Amazon; the jungles of Africa, and the arid plains of Arizona, are all scoured for gain. The temporary and uncertain advantages of artificial prices depending on the caprice of legislature, and the dictum of a popular vote, are weak incentives in comparison, or, as before said, are no incentive at all, tending rather to unhealthy growth, and failure in the main object.

SOME PROBLEMS OF MUNICIPAL ENGINEERING.

By Prof. Charles D. Marx, Mem. Tech. Soc.

A French scholar, writing in Lyons in 1854, made the statement that our country, so proud of its progress in mechanics and in the possession of technical aids, as, for instance, steam, greater than any controlled by the ancients, nevertheless is far from accomplishing, for even the largest of our cities, what the Romans accomplished for the smallest town under their control, and that often in spite of the greatest difficulties. This seems a bold statement, but the truth of it will be apparent if we pass briefly in review what the Romans accomplished in the solution of some of the municipal problems which we find staring us in the face today.

These problems of water supply and sewerage, of the laying out and paving of streets, of the removal of garbage and dust, of public parks and baths, are not problems which the human race is called upon to solve for the first time. If we are willing to profit by the progress made in lines, mechanical and industrial, why do we show an inclination in municipal matters, and especially in sanitary municipal matters, to always revert to a primitive state of things; to build up our structure from the foundation, when we could safely

*Read before the Technical Society of the Pacific Coast, April 7, 1893. Reprinted by permission.

build on the foundations laid centuries ago, which have become firmly settled by this time? But to the proof.

I have chosen as an illustration the city of Rome, not only because it is a city of the past, but also of the present, because it, too, in spite of centuries of experience back of it, had until recent times failed to profit by them. Originally a number of hills near the banks of the Tiber, and a few miles from its mouth, were settled by a grazing and agricultural community, and such it remained for some time. About 200 years or so after the founding of the city, toward the end of the reign of the kings, agriculture and cattle raising were still carried on within the limits of the city. The streets were unpaved and filthy, human and animal excreta piled around the miserable dwellings lay festering under the hot Italian sun. It is not strange, therefore, that in a city surrounded on three sides by poisonous marshes, without any system of drainage, and with an internal condition of affairs as sketched above, it is not strange, I say, that malarial fevers carried off hundreds, perhaps thousands, of human beings. As Doctor Lauciani says: "The clearest proof of the virulence of malaria in the first century of Rome is afforded by the large number of altars and shrines dedicated by its early inhabitants to the goddess of fever and other kindred divinities. It was not, however, until the *prayers* to the gods were supplemented by *action* on the part of the citizens and administration that a change for the better took place. To Tarquinius Priscus, the fifth of the kings, must be given the credit of having directed the first systematic works for the drainage of the town, and it was for this latter purpose alone that the first sewers were constructed. They were to give an outlet to the ponds, swamps, and marshes which stretched along the valley between each couple of hills, rather than to serve as sewage carriers in the modern sense of the word, for at that time Rome had not yet entered upon its period of water works construction. The fact that a number of these sewers have stood for more than two thousand years, and that one of them at least is in use even at the present time, speaks volumes for the quality of municipal work in those days, No cavities back of the arches full of empty cement barrels were found, as was recently the case in the construction of the Croton aqueduct for the city of New York. No scamped work, as the investigation of some of the public works in Washington disclosed. It is likely that to a body of reliable contractors was added a corps of honest inspectors of public improvements. The claim is advanced that we have lost the art of making mortar as strong as

the Romans, and hence the poorer quality of a good deal of our municipal work. I am inclined to look elsewhere for the cause. But to return to Rome.

The sewers, of which I have just spoken, emptied directly into the Tiber, and the full effects of such an arrangement made itself felt as the city grew, as the sewers became true sewage carriers, and as the pollution in the river increased daily. Having no knowledge of the modern germ theory of disease, the Romans may well be forgiven for this error in the planning of an otherwise admirable system.

That the Roman sewers primarily served the purposes of drainage is further evidenced from the fact that they antedated the construction of aqueducts or water works by some centuries. A Roman water works' superintendent, writing in the first century after Christ, states as follows: "During four hundred and forty-one years the Romans satisfied themselves with the use of such water as they could obtain on the spot, from the Tiber, from wells, or from springs." This period was followed by that of the construction of those wonderful masterpieces of engineering and architecture — the Roman aqueducts. It is true that in our modern times most of these structures would not be erected, but the Roman, ignorant of the use of cast and wrought iron for pipe material, had to construct those masonry channels in which to carry the water across deep valleys and gorges. I do not think that even the most rabid modern materialists are likely to bewail the Roman ignorance on this score. Dr. Lauciani concludes, as to the extent of the Roman aqueducts, that "eighteen springs were collected and canalized by the Romans from distances varying from a minimum of seven and a half miles to a maximum of forty-four; the waters were brought to Rome by means of fourteen aqueducts, the length of which varies from a minimum of eleven miles to a maximum of fifty-nine. The average length of these aqueducts amounts to three hundred and fifty-nine and one third miles, of which three hundred and four miles are underground, fifty-five above ground; the channel being carried on the top of really triumphal arcades at prodigious heights, sometimes exceeding one hundred feet." A tunnel, three miles in length and three feet by seven feet in cross section, between Tivoli and San Gericomio is another interesting feature in connection with the works for the water supply of Rome; but not into the city alone, into the surrounding districts also was carried an almost inexhaustible supply of pure cold water. Assuming for Rome a minimum popu-

lation of 2,000,000, which by some is supposed to be fifty per cent. in excess, we find that one hundred and twenty gallons of water were furnished per inhabitant per day; if there were but a million then we have two hundred and forty gallons per day, a quantity more than twice as great as is usually assumed in water supply estimates for large modern cities.

Beginning with the year 11, before Christ, water was furnished free of cost. Up to that time a small tax had been paid, but it could not have been a heavy one, for Strabo, writing in the latter part of the first century, B. C., mentions the existence in almost every Roman house of reservoirs, pipes, and fountains. Such a quantity of pure, clean water furnished for practically nothing led, naturally, to great habits of personal and municipal cleanliness, a matter of so much greater importance since closely-packed tenement houses and narrow winding streets would otherwise have exerted a far more pernicious influence than they did.

Intimately connected with the lavish water supply grew up a system of public baths, such as the world has never seen before or since, a system not confined to the city alone, but extending far into the outlying villages, into the country, and into the provinces. In fact all the people, even the country people, became so accustomed to their daily bath that they sorely felt being deprived of it. Seneca sees in this all-pervading cleanliness a sign of the decadence of the times, for formerly, as he puts it "a daily washing of the hands and feet and a bath once a week was deemed sufficient." At the end of the third century after Christ, Lauciani says: "Rome numbered eleven large thermæ, and 926 smaller ones conducted under private enterprise. The baths of Caracalla alone could accommodate at one time 1,600 people; the baths of Diocletian, 3,600; taking 1,500 as the average accommodation of the public thermæ, and 50 as that of each of the private baths, we learn that in ancient Rome at any minute 62,800 citizens could restore their strength in baths of every description; and this without bringing into the calculation, the Tiber, the Arnio, the lake Agrippa, and the bathing accommodations with which every Roman house was abundantly furnished." The cost of a bath was about three eighths of a cent.

The small agrarian village of which I spoke as Rome in the beginning had grown in the course of time into a capital as important as any in modern times. The lack of foresight in planning systematically for the development of the town had carried its own punishment in its wake. When in the year 390 B. C., about 363

years after the founding of the city, it was sacked and burned by the Gauls, an opportunity was offered for remedying the errors of the past in rebuilding the city. But no advantage was taken of this opportunity. Irrespective of old street lines, without regard to any plan, without regard to the already existing system of sewers, the new city was built upon the ruins of the old. The Emperor Augustus, in the last century before Christ, tried his hand at improving the network of city streets, he succeeded but slightly. Far more successful, because less conservative, was Nero in the year 64 after Christ. He had to resort to strategy in order to carry out his plans for improving the city, however, because superstition and the greed of private owners of property balked his way. The method he used was simple, but unfortunately cannot be used in this 19th century. Lauciani summarizes the work done by Nero as follows: "He ordered his favorite architects, Severus and Celer, to draw a new plan of the city, and to draw it according to the best plans of hygiene and comfort. Then he caused an enormous quantity of wooden booths and tents to be secretly prepared, and ordered fleets of grain-laden vessels to be kept in readiness to sail from the various harbors of the Mediterranean at a moment's notice. Having taken all these precautions, and insured the success of the strategem as far as human foresight could, Nero set the whole city into a blaze of fire, and did it so neatly that in the fourteen regions, or wards, into which Rome had been divided by Augustus, three were annihilated completely, and seven for the greater part, and yet not a single human life seems to have been lost in the gigantic conflagration. The homeless crowds found a ready and comfortable shelter under the booths and tents raised by thousands in the public parks and squares. At the same time a large number of vessels laden with grain from Sardinia, Sicily, Numidia and Egypt appeared at the mouth of the Tiber, and relieved the emperor from any anxiety as far as famine was concerned. These vessels, as soon they had discharged their cargoes, were filled up again with the debris of the conflagration, which they threw into the marshes surrounding the delta of the Tiber.

"Even in our age of progress, material, improvement, and comfort we cannot help admiring the profound wisdom shown by the two imperial architects, Severus and Celer, in designing and rebuilding the city. The straight line and the right angle were followed, as far as could be done in a hilly country, in tracing the new streets and avenues through the still smoking ruins. Haste and irregular

constructions were forbidden. The line of frontage of each new building had to be sanctioned and approved by one of the official surveyors. Large squares were opened in place of filthy thickly-inhabited quarters. The height of private houses were supposed not to exceed double the width of the street, and porticos were to be built in front of each one to provide the citizens with cool sheltered walks in case of rain or excessive heat. Lastly wooden ceilings were excluded from the lower story of private dwellings, and absolute isolation on every side was made compulsory."

But even this reconstruction of the city could not do away with all the existing evils, it was but a partial remedy at best. Even after the fire, according to the consensus of opinion of the ancients, the houses were pushed skyward. Juvenal and Pliny are cited to this effect by my informant. There seems to be every reason to believe that, with a maximum width of the main streets of from fifteen to twenty feet, the fronts of the houses were often as high as fifty to sixty feet, whilst the rear part of the houses was usually much higher. With a population as large as that of New York, crowding and jostling in these narrow thoroughfares, we need not wonder that in the history of the city it soon became necessary to forbid all driving in the streets during the day time. All teaming and hauling had to be done during the night, and in the early evening and morning hours. To this there were a few exceptions. Materials for public buildings could be hauled through the streets of the city during the day time. Garbage collectors, and the priestesses of Vesta were also allowed to drive through them. Surely this is a case of the meeting of extremes.

But as I have said above, all regulations, all partial reconstructions of the city could not make amends for the lack of a wisely conceived city plan in the beginning. The Rome of the present century — of our days in fact — is taking the final steps for the correction of the errors of the past. Whilst criticising thus freely this, the most serious defect in the municipality of ancient Rome, there are a few other public institutions which these far-seeing people provided, from which we cannot withhold our unbounded admiration. But the two of which I am about to speak must not be counted among the number.

It seems strange that in so progressive a city as Rome no attention should have been paid to the matter of public lighting of the streets. With approaching darkness the houses and stores were locked and bolted. Poor people compelled to be out at night

carried their own lights, people of means were preceded by torch-bearing slaves. In spite of a large police force of seven thousand men, however, the streets of Rome were not safe at night. Assassins lurked in the deep shadows of columns and porticos, and happy was the belated citizen who suffered nothing worse than being tossed in a blanket by the roystering sprigs of nobility out for a lark.

I have already stated that a system of garbage collection existed, but the method of the disposal of this material was as crude as it is in most of our cities of the present day. Everything was carted to huge dumps and left to decompose in the open air. That an intolerable nuisance was thus created became apparent to the Romans as long as two thousand years ago. Sanitary rules to abate, or at least mitigate the nuisance, were passed, and Dr. Lauciani in his excavations has unearthed some of them graven on stone. Here is the text of one: "C. Sentius, son of Caius the Praetor by order of the senate has set up this line of terminal stones to mark the extent of ground that must be kept absolutely free from dirt, and from carcases, and from corpses. Here also the burning of corpses is strictly forbidden." Another hand, probably that of a man living in the neighborhood and within reach of the effluvia of the place, had written in huge red letters, the following entreaty at the foot of the official decree, "Do carry the dirt a little farther, otherwise you will be fined." This line of stones, beyond which the refuse of the town could be legally thrown and be allowed to putrify under the burning sun, was only four hundred feet distant from the walls and embankments of Servius Tullius. On the day of the discovery of the above mentioned stones, June 25, 1884, Dr. Lauciani was obliged to relieve his gang of workmen from time to time, because the smell from that polluted ground (turned up after a putrefaction of twenty centuries) was absolutely unbearable, even for men so hardened to every kind of hardship as his excavators. The greatest of these nuisances, the dumping ground in the vicinity of the Esquiline Cemetery, and the latter itself, were covered over at the beginning of our era by twenty-five feet of soil, and the one third of a square mile turned into a garden. This is the place at which the excavations above referred to were made. Can any modern board of health look for stronger proof in support of its measures than the instance just cited?

But though the street system of ancient Rome, the methods of cleaning the same, and of the disposing of the garbage and waste left much to be desired, we must admit along other lines amends

were made to the greatest extent possible. Open squares, gardens, and parks innumerable in the city counteracted the effects of the narrow, winding, and stifling streets, in which the smoke of the kitchens was mixed with clouds of dust. Many of the parks, though owned by private parties, were opened to the public. From roofs and balconies, flowers and shrubs exhaled their perfume, and shaded walks under laurel and plantain tempted the wanderer on the Campus of Mars.

A brief reference, before we leave this great municipality, to the markets and slaughter houses. Here too we find the most liberal and painstaking provisions; the ample water supply proving a great help in keeping these places sweet and clean.

Turn we now forward to the end of the present century; can it be honestly stated that our municipalities of today have learned the lesson taught by the past? Bitter experience has come to the older cities on the Continent,— disease, death, and waste of moneys, the necessary consequences of such a heedless course. Are we in the new world to follow their example, and not rest content until we have been taught by this same stern taskmaster of our own experience? Do you not know that in every one of our communities these old world problems must in turn arise, and additional ones caused by our modern industrial development?

Water supply and sewerage, street paving, sprinkling and lighting, are these not subjects dear to the taxpayer's pocket? Is not the solution of these problems one of vital interest to every citizen of a community, looked at from a higher standpoint than that of mere money? Yet I feel no hesitancy in saying that the importance of these subjects is far from fully recognized by the majority of our citizens. If we look at the matter merely from a business standpoint, the one which the adherents of every short-sighted policy prefer to take, I think it can be shown, by a calculation made by Professor Delos Fall with reference to typhoid fever, that the unsatisfactory solution of these problems pays.

"Forty thousand people in the United States die every year from typhoid fever. For every person who dies with this disease at least ten are sick. So there are sick in the United States every year from this one disease on an average, 400,000 people. For every person thus sick the time and attention of at least one other person is demanded either as nurse or otherwise. Then 800,000 people in the United States each year are either suffering from or attending those who are suffering from this disease. You may go

further in the computation. The average duration of this disease is about 28 days, or in the aggregate, 22,400,000 days. If money considerations could ever be placed beside the value of human life, an easy estimate at say one dollar a day for each of these would show a financial aspect of the case to be very serious indeed. This from one disease alone. Add to it the large number of other filth diseases with their attendant sickness and death, and the problems before us for study at this time stand out in gigantic proportions."

Take the sanitary conditions of some of our lake cities as regards the important relation of water supply and sewage disposal, The most striking instances that occur to my mind just now, are Cleveland, Milwaukee, and Chicago. Though we know that after the destruction of the aqueducts at Rome the populace for a time again drank the water from this same Tiber into which it discharged its sewage, we also know that this was at a period of decadence of the town. Unfortunately in the case of the three cities mentioned above at least, and many more that I might add, the order of things has been reversed, and during their period of growth and development they propose to drink from those bodies of water into which they discharge their sewage. Outlet of sewer and intake of water works are so placed that safety of the cities' water supply against pollution cannot be guaranteed. The recent scare in Chicago is too fresh in your minds to need more than a passing mention. As that city proposes to receive the nation as its guest this year, it is a matter of supreme importance to all of us that no such danger should occur again, that the city should push energetically towards the completion of its well designed sewerage system.

I have just chosen for illustration examples from the middle United States. Perhaps I might find some nearer home, but as it is always more comforting to realize that someone else is worse off than we, let us glance but a moment at the sanitary condition of London, which oftenest of modern cities has been compared to Rome. Repeated Parliamentary commissions have sat upon the question of water supply and sewerage for this commonwealth, but up to today no satisfactory solution of the problems has been adopted. Private companies as heretofore, continue to supply the city with limited amounts of water of greater or less purity, often less. The Thames until recently dragged its sewage polluted waters seaward. It is to be hoped that the newly elected council of London will at last be able to deal in a satisfactory manner with these important problems.

If so little attention has been paid in many of our modern cities to such vital questions as water supply and sewerage, you may well believe me that still less attention has been paid to such apparently minor matters as decently paved streets, kept in good repair, swept, and sprinkled, efficient systems for the collection of garbage, public markets and slaughter houses, and last but not least, public parks. The prevailing opinion in almost every city of the United States is that a pavement of any kind, no matter how poor, once put down will take care of itself. Well, it usually does, but in a way hardly expected by the tax payer. If the old truism of "a stitch in time saves nine," can be applied to anything, it certainly can to such a subject as street paving, no matter whether the material is wood, stone, or asphalt. Timely repairs and cleanliness are as much a matter of life and death to a pavement as they are to a human being. The additional fact that dirty and dusty streets are not the only cause of their own destruction, but must also be held responsible for the destruction of many lives, is, perhaps, not apparent at once, so let me quote from an interesting article by Dr. Bennett in the June *Sanitarian*:

"The atmosphere we breathe is filled with suspended matter of the foulest and filthiest kind, in the shape of dust particles ground from the pavement, ashes, the dejections of animals, the dried and pulverized sputa of a million persons, garbage, dead animals and offal, besides the poisonous gases from ten thousand factories and sewers. In 1872 I mentioned, without then fully recognizing the importance of the suggestion, the possibility of micro-organisms in the suspended matter of the atmosphere playing an important part in the production and perpetration of catarrh. In opposition to this it may be said that the disease is very generally prevalent over the whole country. But this statement requires qualification. Catarrh is most common in large cities, and the dirtier and dustier the place the more prevalent it is. Other things being equal, I believe the more dust in the air (pulverized filth I mean, not clean dust) the more cases of catarrh one will meet."

Street sweeping and intelligent street sprinkling are therefore, it would appear, also matters of considerable importance in a city's sanitary condition.

What shall I say of the question of garbage and refuse, collection and destruction? Does not the extract which I quoted from Dr. Luciani prove fully the necessity of intelligent systematic action, lest our negligence stink to heaven two thousand years from now,

as did that of the Romans in this century? The last report of the special committee of the American Public Health Association gives a most discouraging resumé of the condition of even our largest cities in this respect. Many of them, almost all of the small ones, are still following Rome's example. It is time that a halt were called and this waste matter disposed of by cremation, so as not to become a source of danger in the present and in the future.

As said before, in the mere matter of street lighting we are ahead of the Romans; but that does not necessarily imply that we have any reason to feel particularly proud of the progress made in the two thousand years, as long as the old fashioned lamp-posts and the still worse looking electric light posts, carrying their death-dealing wires, are allowed to disfigure our streets, we will have ample scope for improving the condition of things. As to parks, the necessity of which has at last been realized in our most progressive cities, we still have a good deal to learn from the old Romans. San Francisco, New York, Rochester, and many more cities have made suitable provision that plenty of breathing places shall be left in their centers. Wide streets, admitting the possibility of rapid transit and of the construction of special rapid transit lines must be planned, to prevent that congestion from which Rome suffered. I am glad to see that work in this direction is progressing more rapidly in America than elsewhere, though as Mr. Clark says:

"The history of rapid transit is a doleful one in each case, because the demand for more has arisen so much more rapidly than it was furnished, at least in American cities. In Europe the effect has been to crowd the people into the middle of a city; the effect here in America is to enable them to live in the fresh air of the suburban districts, where they sometimes have room even for a small garden."

The 19th century, as far as the opportunity of the masses for bathing is concerned, seems strongly inclined to Seneca's belief, but I hail gladly the evidence of such a decadence as is shown by the establishment of free, or nominally free public baths in many of the cities of the Continent and England, and also in some American cities. The New York Association for Improving the Condition of the Poor, has erected a public bath capable of providing nearly one thousand baths daily. "These are fitted up" Mr. Patton says, "with every facility for bathing in comfort and with all possible sanitary precautions, following the plan so successfully tried in Vienna. Most of the baths are supplied with warm showers or sprays so

that every impurity is immediately carried away and any risk of infection is absolutely removed. For the same reason the towels will be steamed after use and the cake of soap given to each bather will not again be used in the baths. A charge of five cents will be made for each bath, including the use of a clean towel and a cake of soap. But tickets will be given on the most favorable terms to institutions, societies, churches, and donors to the Association's funds, so that the advantages of the baths may be wide-spread and extended.''

I think I have shown you fully by this time that the problems of municipal engineering which confront us are of supreme importance to you all as human beings and as taxpayers. I have sketched the solution of some of them as carried out in a sister republic thousands of years ago, but recognizing a changed condition of things, though the problems remain the same, you may well ask, what are we going to do about it? How are these problems to be solved in our day? To my mind the question at once becomes the larger one of municipal government, and that such it undoubtedly is, is shown by the action of some of our most progressive American cities, foremost of which I might mention St. Louis, a town conspicuous for the honesty, efficiency and technical ability shown in the administration of its departments, notably that of public works. Time is too short for me to go into a discussion of the revised charter of the city of St. Louis. Those interested will find plenty of food for thought in Mr. Moor's admirable paper on this subject in the Journal of the Association of Engineering Societies for March 1892. A few general considerations, however, may well be in place.

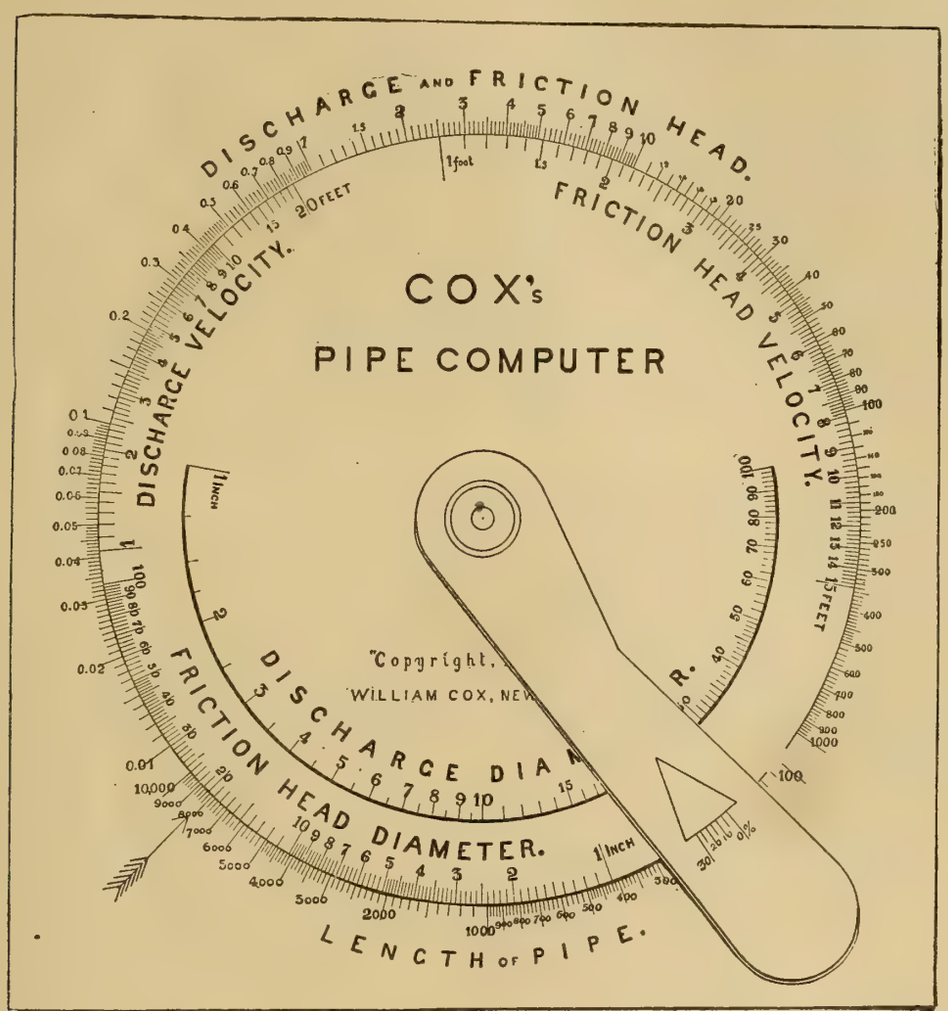
In almost all municipal governments the money spent annually for improvement along the lines indicated is far in excess of that spent for other purposes. The problems themselves, as you will admit, are weighty ones. They should be given the most careful consideration. The planning of all works should be done by men competent to foresee the needs of the city in the future. The work itself when carried out should stand as a monument to the ability of the designer, the honesty of the builder, and last, but not least, the intelligence of the community, and right here, I think, ladies and gentlemen, lies the main difficulty. It may be a bitter pill to swallow, but if any community, in this republican commonwealth at least, fails to solve successfully for itself these weighty problems, it has only itself to blame. Ability to design a system of water

works, of sewers, to lay out a park, or build a public building, does not go with the profession of a Republican or Democratic faith. If a competent Democratic engineer plans an admirable system of sewers, and the construction falls into the hands of an incompetent Republican successor, or vice versa, what profits it the city? Yet instances of this kind are not impossible. Is there any rhyme or reason in calling a man to a position requiring professional ability, and then ousting him with the next turn of the political wheel? If under such conditions men of ability are found occupying some of our municipal offices it is something devoutly to be grateful for, but no thanks are due to the system. If ever a community should be on the lookout as to the fitness of the men to whom it proposes to confide its offices of trust, it should be as regards the fitness of the men to whom it proposes to confide the carrying out of its public works, to whom it confides its public health. But too often the opinion seems to prevail that because Tom, Dick or Harry is a good hand to run the political machine he must be a good man to place in charge of a modern high-duty pumping engine, or that a man who is known to have sold his vote is implicitly to be trusted when placed as inspector on some public work. Such are not the methods of political administration by which these weighty problems are to be solved.

The community at large, we, the citizens, must recognize two things, that national politics must be swept out of municipal affairs, and that a good thing costs and is worth money. The moment the first point is fully recognized the attention of every community will be directed toward finding the best man, and it will often find him in its midst, for filling the responsible position of director of municipal works, of city engineer. Such a man once secured, the community, if it be an intelligent one, and I hope the day is not far distant when all our communities may be classed under this head, will continue to retain his services as long as it can. Vide again the example of St. Louis, and its relation to Col. Flad. I said that almost every community would be likely to find a competent man, or body of men, in its midst to take charge of its municipal works, but believe me they are not the men who put themselves forward. They are men who allow their work to speak for themselves, and whom the office must seek. Men with the ability needed for planning such works, and the honesty for carrying them out for the best interests of the taxpayers, have self respect, a vital obstacle for securing an office which is only too often considered, when it does exist, a share of the political spoils.

The second point, the one of expense, is almost as vital as the first ; for if you put a good man in a place, then tie his hands, and do not furnish him the money for carrying into effect his plans, you can readily make his administration a failure. The policy that those public works are the best which cost the least is a mistaken one, though I confess it has been the prevailing one in most of our cities. Those *good* public works are the best which cost the least. Letting contracts to the lowest bidder often results in under-cutting legitimate prices and profits to such an extent that the contractor must cover himself by scamping his work under a dishonest inspector, or doing a losing job. Generally the former is the case. Instances are numerous, and the cities in which they occur are only following a penny wise and pound foolish policy.

California is called "Our Italy." We glory in the fact. Perhaps it behooves us all the more then to profit by the experience of our sister community in the old world. I have shown you the far and short-sightedness of the Romans in their municipal administration. Do not let it be said a thousand years from now that we no more than the older cities of the Continent knew how to profit by the past. Building on a virgin soil, in a congenial climate, our cities still in an embryonic state, let us plan for their development with the welfare of those who come after us at heart. Let us give them wide, beautiful streets shaded by trees, spacious parks, pure water, public baths, effective sewerage. If we but solve these problems well, future generations will rise up and call us blessed.



INSTRUMENT FOR PIPE COMPUTATIONS.

Mr. William Cox, C. E., of New Brighton, N. Y., has devised in a very ingenious manner, some instruments for graphically demonstrating quantities, not as curiosities, but as practical working implements for engineers and others.

The drawing above shows one of Mr. Cox's instruments directed to a problem of a good deal of complexity to any but those skilled in computations — the capacity of pipes for conducting water, and of use even to those who are familiar with such calculations, as a "check" upon their work.

Mr. Cox sends the following description and explanation of the pipe instrument :

"The pipe computer consists of a graduated dial with an inner revolving graduated disc, the whole mounted on a substantial board 12 inches square, with brass center swivel and locking nut. There

are various scales on the computer which correspond to the different terms of the formula whose solution is desired, and their relative positions on the dial and disc are determined by their positions in the formula of which they are the terms.

The following formula is employed for the friction head. It gives almost the same result as that of Weisbach :

$$H = \frac{L}{1200D}(4V^2 + 5V - 2)$$

The formula may be further simplified, and by the graphic reduction of $4V^2 + 5V - 2$ into one term, expressed thus,

$$\frac{H}{V} = \frac{L}{D}$$

in which

H = Friction Head in Feet,
V = Actual Velocity of the water in feet per second,
L = Length of Pipe in feet,
D = Diameter of pipe in inches.

The other scales enable the discharge in cubic feet per minute for any given diameter of pipe and the velocity of flow to be at once ascertained, the formula used in this case being the usual one :

$$\left.\begin{matrix}\text{Discharge in } C. \\ \text{feet per Min.}\end{matrix}\right\} = \text{Velocity} \times D^2 \times 0.7854 \times \frac{60}{144}$$

which is expressed graphically by

$$\frac{\text{Discharge}}{\text{Velocity}} = \frac{\text{Diameter}}{1}$$

The instrument includes the following scales :

1. On the dial — top — discharge and friction head.
2. On the dial — bottom — length of pipe in feet.
3. On the disc — top — friction head velocity.
4. On the disc — top — discharge velocity.
5. On the disc — bottom — friction head diameter.
6. On the disc — bottom — discharge diameter.

Note 1. When discharge is required, the scales, discharge velocity, and discharge diameter, must be used, and when friction head is sought, the scales friction head velocity, and friction head diameter, must be used.

Note 2. The top scale of the dial serves for friction head, and *also* for discharge. When used for the latter, the readings are to be multiplied by 100 to obtain the cubic feet per minute.

The method of operating the computer is exceedingly simple, all that is required, being, *in the first case*, to set the given diameter (D) on the dial opposite the given length (L) on the disc, when opposite the velocity (V) on the disc, is at once found the friction head (H), on the dial ; and *in the second case*, to bring, by means of the radial edge of the arm, the given diameter to coincide with the arrow (answering to the denominator 1) when the discharge will be at once found opposite any given velocity.

To add any percentage to the friction head ; set zero of the arm scale to any graduation, (say 1 inch) of the scale of friction head diameters, then turn the disc round until the *same* graduation is opposite the required percentage ; this amount will then have been added to the friction head.

The method adopted of combining the terms of the formulæ enables a fourth term to be at once found when *any three* are known. Comparisons may also be made of different combinations of diameters, velocities, etc., their results noted and the most appropriate selected, thus saving what is in such cases, by the ordinary method of computation, a laborious undertaking.

The following examples will illustrate the facility of use :

1. Given :— Pipe 12 inches in diameter, 4,100 feet long, and 3 feet velocity. Find friction head.

$$\frac{\text{Set 12 in. Diameter}}{\text{over 4,100 feet}} \text{ then } \frac{\text{Find 14 ft. F. Head}}{\text{over 3 ft. velocity.}}$$

2. Given :— Pipe 10 inches diameter, and 13 feet velocity. Find discharge per minute.

$$\frac{\text{Set 10 in. Diam.}}{\text{opposite arrow}} \text{ then } \frac{\text{Find 425 cub. feet}}{\text{over 13 feet velocity}}$$

3. Given :— Pipe 8 inches diameter, 900 feet long, and 30 feet head. Find velocity and discharge.

$$\frac{\text{Set 8 in. Diam.}}{\text{Over 900 feet}} \text{ then } \frac{\text{Under 30 feet head}}{\text{Find 8.4 feet velocity}}$$

$$\frac{\text{Set 8 in. Diam.}}{\text{Opposite arrow}} \text{ then } \frac{\text{Find 175 cub. feet}}{\text{Over 8.4 ft. velocity}}$$

The pipe computer will also be found particularly useful in those numerous cases in which the length of pipe and the head alone are known, and it is desirable to find a suitable diameter of pipe and velocity of flow to obtain a given horse power by means of a turbine or water wheel.''

There are a number of these instruments in use on this coast, and by various firms over the country, who report very favorably upon the convenience of their use. One of them can be seen at the office of this Journal. The price is $5.00.

LITERATURE.

Cassier's Magazine.

MARCH 1893.

The present is a most excellent number of this fine magazine, continuing the almost classical account of Mr. Edison's life and inventions, by A. and W. K. L. Dickson; an interesting and clear description of explosive apparatus for coast defense, by Mr. Atwell; an essay on gas and oil engines, by Mr. Albert Spies, and an account of the Niagara Falls turbine water wheels, by Mr. Clemens Herschel. with much other matter of value and interest.

This Magazine, which has attained a prominent and prosperous place in this country, is to be issued in England as a distinctly separate publication there, which means, no doubt, that that matter of only local interest in either country will be excluded from each edition.

The principle of double or multiple use of technical matter here arrived at, and now to some extent applied in other cases, is a powerful aid to the excellence and value of it. Not only are the resources widened accordingly, but the character of the matter, and its worth, may be vastly increased over what "single use" will permit. There is also the happy recognition of the fact that science and the arts are universal, not only as to nature, but also as to use, and not surrounded by a wall of bigotry and prejudice, such as pertain to the commercial relations of countries at this day.

The scientific man of our time has nothing to do with these unfortunate traits that find expression in a desire to quarrel with and injure some one of another country or race. The color of a man's skin, or the place of his nativity, are not the principal facts of his existence, but what he knows, or can teach, is the measure of his place in the brotherhood of research.

This double edition of Cassier's Magazine is a demonstration of this universality of technical effort and research, potent for good, and a rebuke to wars, alliances, treaties and trade restrictions. It indicates freedom in one direction at least, and deserves all possible encouragement.

The Technological Quarterly.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

This number contains one of the most valuable and interesting essays that has been contributed to technical literature for years past, useful because furnishing information on a subject of universal application, and interesting because of a masterly and exhaustive treatment. We mean the leading article by Mr. S. R. Koehler on "Photo-Mechanical Processes."

The methods of producing prints or pictures that have undergone complete revolution under photographic processes are to most people a profound mystery. Even wood cutting, centuries old, is not understood. We recently sent a block drawn upon for inspection before cutting, and received in return from a prominent firm instructions to have some electrotypes made at once as the work was very satisfactory. This is strange in view of the fact that everyone, even children, are continually examining and admiring prints.

In the article named the processes are divided into three classes or types, the "relief" one, wherein the face stands even with the surface, and the void part is cut away.

The "itaglio," or "cut in" process, wherein the lines or surfaces to print are cut down into the plate, filled with ink, the surface cleaned, and the paper pressed on, so it sinks into the grooves or depressions or by affinity takes up the ink. These are the old well-known processes, including wood, steel and copper-plate work.

The third class includes what the author calls planographic methods, or printing from planes that are neither in relief nor itaglio. Among processes of this kind one is old, or at least is not new, that of stone printing or lithography, in which the ink is distributed on the stone, and taken up by affinity, but the latter processes under this head, to which the paper is mainly directed, have opened up a new branch of the art, one of great diversity and of surpassing perfection. It is only five years since photo

prints were as exceptional as they are now common, indeed one sees little else in the finest literature of our day.

These "photoplanograph" processes are here made quite simple, but our space will not permit explanation, only to say, as most people know, that their base, so to call it, is in the chemical changes wrought by light.

The second article, by Dr. W. T. Sedgwick, on "The Causes and Prevention of Asiatic Cholera," gives hope and promise, as do other views of our day, that this dread foe is near meeting a check, if not eradication, in the temperate zones.

The able article, here presented, is entirely divested of medical pedantry, and is as common sense and plain as language will permit. Its plainest inference is, how powerless we are to apply what is definitely known without waiting the tedious years of evolution. Our quarantine methods, for example, are predicated on methods of infection that do not exist in the case of intestinal disease.

Sir Edwin Arnold, when he was here, laughed at our cholera scare, and with reason, if Dr. Sedgwick and other eminent authorities are correct. The means of infection are unsuspected, and that far are alarming. We recommend our readers to examine the article referred to.

Catalogue of the State Agricultural College, Michigan.

There is something anomalous in the wonderful provisions made in this country for education. These are cumulative and overwhelming, destined unquestionably to modify in great degree the near future in all callings and avocations.

There is, perhaps, no industry wherein a a good education has more real value than in that we call agriculture. People operate separately, and must depend on themselves for resources. Their duties last only through the light of day, and the evenings can be devoted to those enjoyments provided by an education. Several branches of applied science have direct application in farming, and there is no wonder in the fact that agricultural colleges are springing up all over the land.

One is amazed in looking over the very complete catalogue above named, and especially at the plates illustrating the buildings and "plant." There is no history or statistics other than pertains to the course, given in the 75 pages, so there is nothing to comment upon, except the fact of existence in Michigan of an "agricultural" institution of learning that would, without this qualification have been a wonder in our boyhood times.

Michigan it seems, among all the states of the Union, best manages her public institutions of one kind or another. Her labor bureau outranks in real useful work any other we know of. Her educational resources are unsurpassed, even in richer and more populous states. Whether it is the air, the timber, the iron, or the people, that infuses this spirit we do not know, but the fact remains.

Electrical Transformers.

BY CARYL D. HASKINS.

This is a late contribution to the literature of electricity, and has the distinction of being original and useful, besides is written in idiomatic English that is a pleasure to read.

Among the various kinds of apparatus employed for generating and conducting electrical currents, nothing seems so mysterious to the unskilled as transformers. The name is not wholly relevant, but is, perhaps, the best one that can be selected for changing the force of electrical currents. The main office of transformers is to reduce the pressure, as it is called, of high-tension currents generated by alternating dynamos.

The dimensions and expense of conducting wires varies inversely as the voltage, hence there is a strong commercial incentive to transmit under high tension, as we say in mechanics, and then at the point of application lower the force of the current by means of transformers, so as to avoid danger and meet the requirements of lighting, and so on.

The work is thoroughly technical and gives the plainest explanation of pulsating or alternating currents that has appeared. The first chapters are as nearly a popular treatise as the nature of the subject permits.

Electric phenomena can never be understood in a general way beyond its visible manifestations, and we imagine the author has, from a scientific standpoint, done a

that is possible in making the nature of transformers clear.

The third chapter is devoted to the mathematics of the subjects, and the fourth to constructive evolution, and chapter five to specific construction.

In the concluding chapters some of the leading types of commercial transformers are illustrated and described, also in an appendix some correlated matter is given, including a description of welding processes.

The book will certainly take its place as a standard reference one, in all that relates to the branch treated, and as such will be a good model to follow in other essays of the kind. It is sent by Messrs. Osborn and Alexander of this City, who furnish copies at $1.00, which seems a low price for a work of this kind.

Theory of Structures and Strength of Materials.

This extensive work by Prof. Bovey, of Montreal, is an illustration of modern mathematical methods as applied to structures of every kind, and, no doubt, the most advanced and comprehensive one to this date.

Professor Bovey is a member of the two great engineering institutions, civil and mechanical, in England, and is at present connected with the McGill University, Montreal, as Professor of Civil Engineering and Applied Mechanics; is also a Fellow of Queen's College, Cambridge, England.

As intimated last month, a review, or even notice, of a work of this kind, that would make any pretense to analysis, would far exceed both the capacity and opportunity of an editor, and instead must be given some impression of its place among modern text books, where it is certainly designed to occupy a prominent place.

Heretofore the theory of structures has been scattered about, so to speak, in various treatises by Relleaux, Rankine, Unwin, and others, and has not been systematically collected, or grouped in convenient form, so as to include all down to a particular date, as in the present case.

The formulæ employed are as simple as possible, and the text much plainer and more lucid than is common, besides this there is commendable addition of "examples" in the most familiar branches of constructive art that are too often omitted in modern text books. Such examples are a check, or proof, of a correct use of the rules laid down, and have always been employed in other cases as an aid in successfully imparting information.

There is too, in Professor Bovey's work, a nice discrimination between exhaustive and compendious treatment in proportion as the several branches of the subjects demand. On friction, for example, two pages suffice for all that is said or need to be said, because any amount of writing and compilations cannot make clearer the experimental phenomena on which the laws of friction rest. We do not assume that all the conditions of machine friction are summed up here or elsewhere, but what is definitely known is formulated in a concise way, and the matter left there.

The following remarks on "work" will illustrate the author's method of explanation. The term is selected because of its being one of the most difficult to define.

"Work must be done to overcome a resistance. Thus bodies, or systems of bodies, which have their parts suitably arranged to overcome resistances are capable of doing work, and are said to possess energy. This energy is termed *kinetic* or *potential* according as it is due to *motion* or to *position*. A pile-driver falling from a height upon the head of a pile drives the pile into the soil, doing work in virtue of its motion. Examples of potential energy, or *energy at rest*, are afforded by a *bent spring*, which does work when allowed to resume its natural form; a *raised weight*, which can do work by falling to a lower level; *gunpowder* and *dynamite*, which do work by exploding; a *Leyden jar* charged with electricity, which does work by being discharged; *coal*, *storage batteries*, *a head of water*, etc. It is also evident that this potential energy must be converted into kinetic energy before work can be done. A familiar example of this transformation may be seen in the action of a common pendulum. At the end of the swing it is at rest for a moment, and all its energy is potential. When, under the action of gravity, it has reached the lowest point, it can do no more work in virtue of its position. It has acquired, however, a certain velocity, and in virtue of this velocity it does work which enables it to rise on the other side of the swing. At intermediate points its energy is partly kinetic, and partly potential."

The book contains over 800 pages, profusely supplied with diagrams, and, as before said, with worked out examples. It is published by Messrs. John Wiley & Sons, New York, and sold here by Messrs. Osborn & Alexander, price $7.50.

Terrestrial Atmospheric Absorption.

This work of Professor Schaeberle, astronomer at the Lick Observatory, is issued from the State printing office, and is, no doubt, a worthy contribution to the objects for which the observatory was founded. Our notice of this work, which represents a great amount of research, will be easy, and is included in the admission that we know nothing of the subject, except that it is far removed from popular understanding.

The units, and therefore all resulting quantities, dealt with in astronomy are unknown to business, and methods of computation employed in the applied sciences, and the slight insight that one can gain in this abstruse science by analogy inspires only awe and admiration.

The opening paragraph in Prof. Schaeberle's work indicates the nature, or rather the objects, of the research to which his labors have been directed. It is as follows :

"The remarkable revolution in the methods of charting celestial configurations, brought about by substituting the photographic plate for the human eye, has opened up a most inviting field of investigation. To obtain results which heretofore demanded months and years of labor on the part of the observer, only a few hours are now required."

Naval Progress in 1892.

The U. S. Naval Intelligence Office, under the charge of Commander C. H. Davis, has issued an extensive report on "The Year's Naval Progress," embodying such reports on ships, torpedo boats, machinery, ordnance, administration, electricity, maneuvers of 1891, and armor.

These essays were prepared by officers of the Navy, especially skilled in the departments to which the several sections relate, and is an evidence of the extent and thoroughness of the provisions made for statistical data in this country.

The second section, "Notes on Machinery," by Assistant Engineer W. H. Alderdice, U. S. N., is the one that will most interest our readers. It is in some respects a resumé of Commodore and Chief Engineer Melville's report of the Bureau of Steam Engineering.

The report of the officers appointed to investigate the bursting of the main steam pipe on the *Concord* in 1891 is given, and assumes that the fracture of the pipe was caused by "water hammer," that is, a slug of water driven forward by steam at a pressure of 110 pounds per inch. A section of the fractured pipe was subjected to internal pressure seven times as great as that of the steam without starting the seams, which were, in the pieces tested, the same in appearance as at that portion of the pipe that gave way.

The vessel had been steaming with half her boilers, steam passing over to heat the water in two other boilers, which were to be put into use. When the main communicating valves were opened between the boilers the steam pipe burst, killing two persons and filling the firing room with hot steam.

The Board says :

"After observing this test, and weighing the evidence, we do not believe that the broken pipe gave out at 110 pounds steam pressure, which it will be remembered was the pressure registered on the gauges at the time of the disaster. We are then compelled to look for some other cause. After careful examination of drawings, and their verification, and the weighing of evidence, we arrive at the opinion that the disaster was caused by 'water hammering,' or, as it is called, 'water ramming.'"

While the circumstances do not point unmistakably to this cause, they should call attention to the danger of opening pipes to high-pressure steam when the pipes may contain water. The result is one of clear analogy to firing a steam gun with a slug of water for a projectile, capable of rupturing any kind of a pipe. The remedy is in provisions for draining all pipes.

The account of the failure of the *Baltimore's* condenser tubes forms a report by Assistant Engineer A. M. Hunt, U. S. N. After speaking of mud in the condensers, Engineer Hunt says :

"When the tin coating had been removed at any one point there was then left a brass surface exposed, adjacent to and intimately connected with a tin (tin-lead alloy) surface, and covered by an exciting liquid, sea water. That under such circumstances galvanic action would take place between the two metals cannot be questioned, and one element or the other of the local battery so formed would undoubtedly be attacked. To prove the existence of a current in a couple similar to the above I immersed two sections of condenser tubing, from one of which the tin coating had been removed, in salt water, and found a very perceptible current, using a galvanometer that was not at all sensitive. Zinc is the most electro-positive of all the

common metals, and would in such a couple be the metal destroyed, and that it was destroyed in the altered metal of the tubes is shown by the analysis."

The most remarkable part of the investigation was that the spongy copper, after the zinc had been destroyed, absorbed nearly 3 per cent. of water by weight, and nearly 25 per cent. by volume, evidently tubes of this alloy, copper 60, zinc 39, lead 0.25, is not a good one for tubes.

The notes on ordnance, by Engineer Edward Simpson, U. S. N., occupy 76 pages, and cover all the experiments and advances of the year, and for a more extended period.

Ensign John Blandin contributes the electrical section, which gives evidence of a most thorough acquaintance with this new branch of naval science, if it can be so called. One feature, or one inference rather, is that electrical apparatus of all kinds require modification for sea service.

Coaling and Docking Facilities of the Ports of the World.

This document of 332 pages is issued by the Naval Intelligence Bureau as a guide to navigators, and is a third edition of the publication. There is, of course, not much of popular interest in such a book, but we find in the appendix a table that answers a question often asked, and seldom answered, respecting the comparative value of wood and coal for generating steam.

The following kinds of coal are compared with oak wood, the number of pounds given being equal to one cord, 128 cubic feet of oak wood.

Pennsylvania Anthracite	1,696 lbs.
Welsh Anthracite	1,657 "
Cumberland Bituminous	1,537 "
Pennsylvania Bituminous	1,653 "
West Hartley	1,993 "
Australian Brown Coal	1,646 "
Coos Bay Coal	2,626 "
Mt. Diablo Coal	2,965 "
Wellington "	2,233 "
Seattle "	2,450 "
Scotch Splint Coal	1,970 "
Indiana Cannel Coal	2,046 "

From this it seems that in a general way a ton of 2,000 pounds of coal is equivalent to a cord of oak wood, but oak, while it is most common and hence most suitable for comparison, is by no means so good a fuel as the harder woods, such as beech, hickory, hard maple, and the like. It is better, however, than softer woods of the fir and tulip kind.

Certain kinds of Pennsylvania anthracite evaporates 11.26 pounds of water, another kind only 8.25 pounds of water.

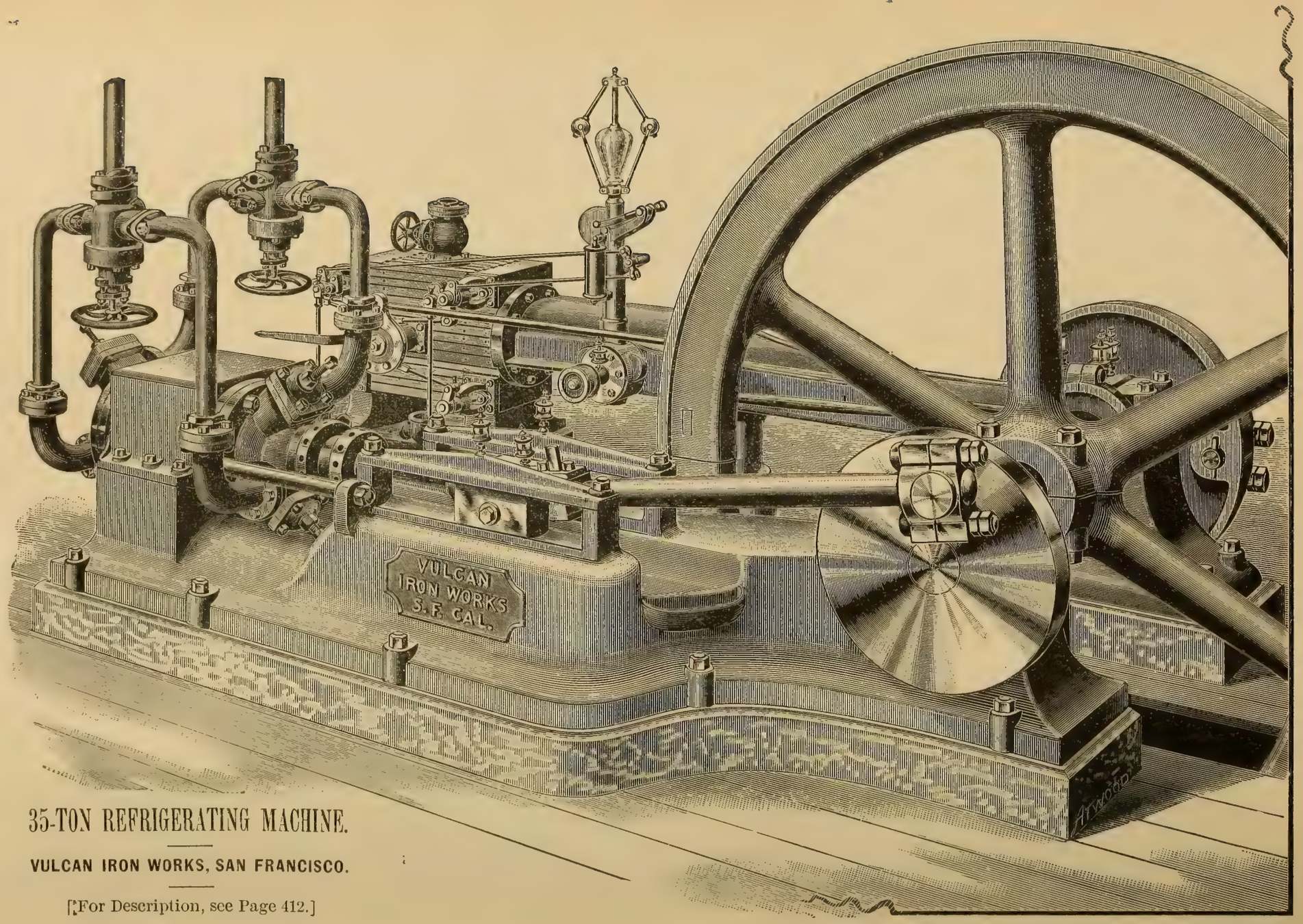
Electrical Measurements and Other Advanced Primers of Electricity.

The above singular title is affixed to a recent work by Professor E. J. Houston, of Philadelphia, and means that the present book, with some other treatises of the same nature, are revisions of earlier ones written in 1884, called "primers of electricity," because intended to teach elementary principles and phenomena; "advanced" in the title meaning that the subject matter is widened to include what has been added to electric science in the nine years intervening.

In the present work, the second volume out of three that comprise the set, the author deals first, and mainly, with "measurements," and that numerous class of implements to which the term "meter" applies, not only in respect to their construction and nature, but the methods on which their action depends. As the work progresses it is expanded to embrace chapters on the various branches of electric science and apparatus, forming a complete treatise, or at least an extended one, of unusual merit.

In the multiplicity of works on electric subjects that are now appearing all over the world, and the fact that the greater share of them cover the same ground, there is little left to be done in the way of review, except to define the quality or usefulness of the books. On this basis Professor Houston's primers have an advanced place, especially in perspicuity, the lack of which is the prevailing fault in such writings.

Pedantry is a weakness hard for writers on technical subjects to avoid, but when the instructor is brought face to face with his pupils, or an audience, or, in other words, is engaged in practical teaching his manner changes, there is no longer any purpose of embellishment or rhetoric, but a strong desire to instruct, so it is not hard to distinguish in electric literature of our time work from the laboratory, work from the school, and the unnecessary work of the compiler. Professor Houston's present work is that of the college or school, and original, which is, perhaps, the best praise that one can bestow. It is published by the W. T. Johnson Co., of Philadelphia, and costs one dollar.



35-TON REFRIGERATING MACHINE.

VULCAN IRON WORKS, SAN FRANCISCO.

[For Description, see Page 412.]

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"INDUSTRY."

JOHN RICHARDS, EDITOR.

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COMMENTS.

The *Vesuvius*, U. S. dynamite-gun vessel, has been at Port Royal, S. C., firing dummy charges for five days, but this far no dynamite has ever been used. The circumstance reminds one of the account that a witty writer gave of an invention presented to the War Department during the Civil War. It was a "double, back-action, revolving Howitzer," open at both ends, charged each way with the powder in the middle. The gun was to be mounted on the ship's capstan, set in rapid revolution, and then fired. The inventor was excused from actually firing the gun, because of having a large family depending on him for support. We have had some experience with dynamite, not a great deal, but quite enough to accept without closer scrutiny, any report made respecting its use as a projectile. It may be set in motion by acceleration and thrown a long distance if the fuses can be depended upon, but a slight mistake in this matter would call for a new gun, and possibly a new ship.

The segregation of government, it may be called, into "commissions," has been going on at a rapid rate for some time past. There are a number of National Bureaus proposed, one of Transportation, one of Manufactures, another of Mining, and so on. In this State we have a goodly number of such bureaus, none of them that

have come up to public expectation, and some of them that have fallen so much behind that they need abolishing. The railway commission for one. The theory of special commissions is all right, and the power of efficient service could be much augmented, but such bodies are too weak to stand against the machinations of our time, directed against public interests. Private interests are growing more powerful and aggressive every year, and safety is more likely to be found in concentrating the executive power than in its segregation. The lesson is taught by the extensive combinations of our time. They are closing up their ranks while the Government is pursuing the opposite course of diffusion, by special "commissions."

The eucalyptus is a wonderful tree and should have an immigration act enforced against it. Not content with growing wherever a foot-hold offers, monopolizing the scant moisture of our soil, and rooting out the sewers in its search for more, it now has the audacity to challenge our pet conceit of this being the home of big trees. Stories of timber growth are usually classed with those concerning fish, and sea monsters, but accounts from Australia that are scarcely disputable, describe eucalyptus trees 400 feet high, 15 feet in diameter in one case, and in another 21 feet diameter at the base; 14 feet, at 78 feet above the ground, and 5 feet diameter at 210 feet above the ground. The height from the ground to the first limbs was 300 feet, and the tree sound, without flaw of any kind. At Cape Otway, Australia, there are trees 415 feet high, or 40 feet higher than any measurement of California sequoias, but the latter have a greater girth, reaching 30 feet, whether sound or not we do not know. There are stumps around the base of Tamalpais Mountain, ten miles from this City, that indicate trees of 36 feet diameter at the ground, and we do not propose to be beaten on all counts.

Mr. W. H. Maher, of Toledo, Ohio, has been travelling in Mexico, and has written for the *Iron Age*, what is perhaps the best account of trade and industries that has appeared in recent years. He says that laborers in the foundries, iron works and cotton mills, work from 12 to 14 hours a day, and receive 37½ cents for that service, also that the wages for skilled mechanics is about 62½ cents a day, and that the highest rate is 75 cents to $1.00 for very skilled men. As Mexico is blessed with an abnormal tariff on most kinds of imported commodities, there is something to be explained here. Mr. Maher mentions that a cabinet-making com-

pany has become very rich in supplying furniture under a tariff almost prohibitory on such wares, and no duty on imported material. No one will wonder at that, but will wonder if the purchasers of the furniture, a much more numerous class, have prospered accordingly. He naively remarks, taxes are not excessive in Mexico, which depends on what is meant by taxes. We are of the opinion that taxes are a chief impediment there.

The *Engineer*, New York, asks why freight cars have to be put on turntables in England. The answer is, that freight cars do not run through or past, but "into" stations there, between platforms. They do not run alongside a platform built along the line and send in a crowd of men with levers, rollers, and so on to "get things out." The wagons, as they are called, are open and any kind of freight that can be grabbed with tackle, is lifted out at one operation and put directly on a "lurry" if one is ready. It is the same with passenger traffic, the carriages are run in between platforms, and a whole train is emptied in the time that ten people could make their way out of a door in the end of the car and down a pair of steps as in this country. "Platforms" change the whole matter of handling freight and passengers. Our railways do not provide them, consequently passengers must go up a stair to get into the cars, and as there is no room for these stairs at the side, they are put between the cars, and this makes the entrance at the ends. Some time, no doubt, we will step out of the sides of our cars on level platforms, when the railways are forced to provide them, but not sooner.

The World's Fair at Chicago has opened under unfavorable conditions in several respects, weather for one, and incompleteness for another, both of these will be remedied, but there is another difficulty that may last throughout, that of extortion practiced on visitors both in and out of the grounds. Tales of extortion are not always to be relied upon, but in this case will have credence all over the world, because the fear of this was one of the principal objections urged against the selection of Chicago as a place for the exhibition. It is a trade city. Buying and selling is the business there, and the whole atmosphere is one of bargains. This was well understood, and the first care of the Exhibition managers should have been to guard against such impositions as the newspapers report. Instead of so doing, the overcharging method has been promoted by

the sale of concessions on the principle of "all the traffic will bear." Even in ordinary times a visitor there from this City is disgusted by the rates charged for accommodations at Chicago restaurants and hotels.

The principal fact concerning the great fair, this far, seems to be in the want of managing ability due to divided power, or a want of power and a liberal understanding of what is required. The architectural and engineering features of the great scheme seem to have been successfuly carried out, but the commercial management has not been. The temper and spirit of exhibitors and visitors does not seem to be understood or regarded, and in the smaller details the fault is most prominent. The reported assessment of $60.00 per horse power to be charged to exhibitors for driving their exhibits, is not only an error, but is shameful extortion. From the centralized stations and admirable arrangements of generating power this charge must be at least three times the cost of producing it, and is poor encouragement for those who incur the other expenses of showing machines in motion, besides, a charge for horse power is not fair on other grounds. The Waltham Watch Company may require one horse power for their great exhibit, and some other exhibitor require more than this for a patent churn.

The arrangement made by the managers to provide oil for fuel at the exposition is a fortunate one, and cheap one too, if the avoidance of smoke and ashes is taken into account, also the avoidance of firemen, although the latter may be considered a misfortune by some who are seeking such work. The amount of steam distribution will be much less than in any previous exhibition, because substituted by electricity, and happily so, if there is to be a charge of $60.00 per horse power to exhibitors, and the electrical companies are not inhibited from supplying power after its passing through their generators. It will soon be time, or is time now, for engravings and descriptions to appear of the mechanical exhibits, and we trust the affluent journals at the East will not leave the main part of such descriptions to come to us through the foreign journals.

The financial management and administration of the great enterprise at Chicago, has certainly been one of much credit. Fifteen millions of dollars have been collected and paid out, without, so far as known, any blunders and losses, such as might have arisen. The same remark, even in greater degree, applies to the architecture,

which if subject to criticism in some respects, as all architecture is, must be conceded as a wonderful success. The construction has been accompanied with a great number of accidents, especially to workmen, due to haste, inclement weather, and the imperfection of handling machinery. The plant, to so call it, has been handed over to the working administration, and now we will see how this part is carried out. It has not started off well, as we have intimated before, but may, if the drift of popular opinion is watched, fall into proper grooves for the crowded period later on.

INDUSTRIAL NOTES.

There appears in our exchanges account of an experiment recently made with a wire-wound gun that was subjected to a pressure of 70,000 pounds per inch, which is almost double what is expected in the ordinary manufacture of ordnance. It is strange that this method of making guns has not made more progress. The Longridge gun made in this manner was adopted, as we remember, by the Russian Government, but for several years nothing has been heard of it. The present gun, made at Birdsboro, Pa., near Philadelphia, is a steel tube 19 feet long, wound with 37 miles of .07-inch wire. The method of manufacture is simple, and the gun cheaper than one of shrunk-on hoops, now the common method of constructing such ordnance. This gun is the invention of a Mr. Brown, and was made as an example for the Government.

Consul O. H. Simonds, at Hongkong, notes the construction in England of a "tank steamer" to carry petroleum in bulk from the Black Sea to China by the way of the Suez Canal, and points out how this threatens the business of American vessels now in this trade. The best way to protect this important trade is to construct tank steamers the same as has been done in other countries. Several have been built in Sweden to the order of Nobel Brothers, owners of the great wells at Baku, Russia. It is very singular that in the vast oil-carrying business done in this country no tank vessels have been fitted up. The handling by means of pumps must be much cheaper in both loading and discharging. The gases or vapor may be an impediment that is avoided by sealed packages, but this seems to have been provided for in the Swedish steamers before named. The Nobel Brothers are natives of Sweden.

It is tolerably certain that the new Cunard steamer *Campania* will make her voyages in about five days, or at a rate of 23 knots or 26½ miles an hour, and this is, no doubt, a limit commercially, if not mechanically, and is fast enough to go through the water. It is about one third faster than our local railway trains are driven here, in California, if there is any comfort in that comparison. In speaking of a "limit" the term does not include "size," because that constitutes an increment in speed that may not be governed by commercial conditions. The *Gigantic*, now being built by Harlan & Wolff, at Belfast, will be much larger, nearly twice as large in some respects, and will, no doubt, distance the *Campania* and *Lucania*. Harlan and Wolff, however disagreeable the fact may be to English builders, have been "on top" since the *Oceanic* came out in 1870. If not all the time, whenever they set out to be, and their record will, no doubt, continue. Many of the features of their ships have been copied, and, except the jointed shaft tried in the *Britannic*, they have no failures in the record.

Reasoning inferentially, it is a wonder that mechanical ingenuity has not succeeded in applying the momentum of railway trains to operate brakes. Here is a power in direct proportion to the requirements of its use, converted to rotative motion in the wheel axles, convenient and at hand, but one that would have to be cumulatively applied, or continued for some distance, and in this fact, no doubt, lies the main impediment. Some experiments are now going on at Boston, Mass., with a view to utilizing train momentum to operate brakes, and with what result is not yet known. The same thing has been tried in many other cases, and in many ways, without any success that has been permanent. The residual effect, so to call it, of all systems is to press the brake blocks against the wheels, involving but little movement, consequently with but little power, and there certainly should be some way to employ the energy of a train for that purpose.

We are of the opinion that Professor Langley, of the Smithsonian Institute, is doing harm with his flying-machine experiments. When someone less known, and less able, chooses to contrive flying apparatus it does not lend especial encouragement, but in his case it is different. Even if he should construct a machine that would sustain and propel itself in the air, no one needs such a contrivance. It is not within the conditions of physical laws to sustain a weight by

"beating the air," except by the expenditure of twenty times the power required to roll the same weight along on iron ways, and a limit of speed is imposed by air resistance in both cases. There can never be safety in operating any apparatus that compensates gravity in such a manner, because the slightest derangement means a "drop." Human vigilance and human contrivance has never been proof against this silent, constant force of nature. Even elevators wound up by means of several ropes, or raised by direct hydraulic pistons, are sometimes caught by gravity and smashed. One must get a foothold against the earth to be safe.

The *Engineer*, London, has published a long article on the subject of roller and ball bearings for machinery, that will, no doubt, do a good deal of harm, because there has always been a tendency to this expedient, especially by the inexperienced, for purposes where such bearings are not suitable. The popular idea respecting machinery is that its chief resistance is friction, and that friction can be avoided by rollers or balls, but the fact is that journal friction is on an average no more than one or two per cent. with well-fitted bearings, and compared with roller bearings causes no loss that compensates for the extra cost and cumbrous nature of the latter. The principal loss by friction, in engines for example, is not in the rotative bearings, but in the piston, piston rod, glands, cross-head slides, and from the atmosphere. Even if anything considerable can be gained by roller bearings, their use must be confined to light loads, otherwise the rollers become pulverizers. A sphere of hard iron or steel rolled under pressure on glass will by pulverization make a white line. The chilled shot used in cutting granite, glass, and so on, is an illustration of this.

Mr. J. L. Heald, of Heald's Works on Carquinez Straits, has furnished some information respecting the removal of encrusted oil from steam boilers that is just now a matter of much importance. In some cases recently weeks have been spent in scraping off the oil that found its way from the condensers and feed water into marine boilers. The *Monterey* and *Peru* are two cases, costing thousands of dollars in expense, not to include loss of time, when, as Mr. Heald claims, all that was required was to put into the boilers some redwood sawdust, which by attrition cuts off the oil, and by a superior affinity absorbs it, leaving the whole as a loose granular deposit in the bottom of the boilers. This fact was discovered by an

experiment at the Starr Flour Mills, near the Heald Works, where a battery of boilers badly oil-coated were perfectly cleaned in a few days' time, and no expense or detention whatever. This is a wonderful and fortunate matter if it turns out the same in other cases, not only for marine but other boilers exposed to oil coating.

In a recent article on the proportions of engine cranks, we find the following: "The proportions of cranks, which exist in practice, have been evolved from practical experience, and are more to be relied upon than the results of any theoretical investigation." This is both truth and error. The proportions of cranks, as cranks, are certainly derived from experience, but the relative proportion of the parts, or members of a crank, are, or can be, derived from computation, and not very well in any other manner. The general proportions, or sizes, of almost any member in machine construction are based on accidental strains, which are not computable, but must be guessed at. For example, an engine maker knows that a crank should be strong enough to punch out the heads of a cylinder, which is cheaper than breaking a crank, because in the latter case he will lose both the cylinder head and crank. He finds out by experience what size the breaking part should be, but not of other parts to match, here is where calculation comes in.

The exhibit of William Jessop & Sons at the World's Fair has been greatly admired. The stand is set in the central part of the building, its official location being British Section northwest central column. The goods displayed are enclosed in a glass case, and consist of cast-steel castings in the shape of small and large gear wheels, pinions, cams, cross heads, cylinder and cylinder cover, spanners, coal-mine car wheels, etc. Some of the castings, all of which are unannealed, have been broken or bent cold, and several have been drawn out into instruments with a cutting edge, such as razor, carving knife, chisel, etc., in order to show the malleability and quality of steel. There is also an arrangement of fractures of various qualities of tool steel, hardened and unhardened, arranged in the show case in pleasing geometrical designs to the number of twelve hundred. There are also finished bars of steel; 12 inch wide, band saws, 54 feet long, and, to crown all, there is an American flag made up of alternate stripes of polished and black steel, with steel stars, nickel plated, which makes a very pleasing effect.

Someone has been at the trouble of inventing a planing machine with a boring attachment, involving a ton or more of details, and a modification of the machine that nearly spoils it for planing, when, as a matter of fact, the only real function gained, is a sole plate, that is, the table of the machine. Nearly all the details relate to driving the boring bar, which can be done with some "picked up" gearing that will cost about one tenth as much as the elaboration set forth in the drawings. Tool combination is a deceptive thing, generally a most undesirable thing. The present is one of the best, if the "rig" consists of a plain self-feeding boring bar set on the table of a planing machine when the latter is out of use, and at no other time, because as before remarked, the platen is the only element of any value in operating a boring bar. A modern boring machine consists only of a soleplate, a bar, and some driving gearing of a simple kind.

Mr. W. H. Wheeler, an English engineer who has been engaged in the business, and written a good deal on the subject of dredging, is contributing in *The Engineer*, London, a series of articles on this subject, in which the cost of dredging is given for a large number of cases, and shows a considerable advance on our practice here. The cost of raising and removing material does not average ten cents a ton, and in many cases falls below five cents for soft material. Taking one case of a suction dredger, the barge was 60 × 20 feet; pipes 12 inches diameter; depth excavated, 25 feet; amount raised, 200 tons per hour; cost per ton, 4 cents; cost of whole plant, $10,000. At Belfast, five million tons of sand and clay were raised and conveyed ten miles at 7½ cents a ton. More than twenty cases are described and the prices given as above noted, and in all of them much less than it costs here for similar work.

The cellulose filling for war vessels, which we always suspected was what the English call a "fad," is likely to be laid away with that long train of inventions for protecting or destroying ships. In the case of the *New York*, that was to have a jacket or lining of this material, the *Marine Review* says it is to be laid aside, stowed in bags, and rammed into the compartments when the ship is likely to be in action. This is the suggestion of her commander. The scheme, as our readers may remember, is that the extreme resistance and tenacity of this substance is such that if a shot passes through

it the hole will instantly close up, and exclude the water. One advantage in all these murdering contrivances is that they are jealously watched in all countries, and no great blunder is possible. Mr. Irving M. Scott went to France some time ago to investigate this kind of material as applied in the French navy, and, no doubt, made a report to the Government, but has not made his views public.

Some recent experiments in France, in respect to the quality of forgings made in hydraulic presses and under hammers, go to confirm just what inference points to in the two operations. The press-made forgings were apparently better in the center, and the hammered ones better on the outside. This becomes an argument in favor of hammers for most kinds of work, because a good surface is very important for both wear and appearance, and also because that is where strength is required. The neutral axis of beams, girders, shafts, levers, and indeed, almost anything, is of little importance, and may even be an injury, the pieces being weaker than if hollow. There may be a good deal more in this than at first thought appears.

LOCAL NOTES.

If the people of California had another $300,000 to be expended in representing the State at the Chicago Exposition, there is no doubt but that some improvement would be made in the methods and administration. The mining exhibit, it is reported, will place this State seventh on the list, when it should have been first, or ranked with the first. The money for this department, $15,000, has been promptly drawn from the treasury, and vouchers, which if audited and passed by any authority, have not been made public; indeed, very little information of any kind has been made public, and the people have no assurance of any result, unless it be that $300,000 will be spent. We have been favored with a good many facts respecting the mining exhibit, but do not see that criticism will do any good now. It is a natural result of the present system of administration in such matters, when there is no centralized authority or checks upon procedure as the work goes on, or does not go on.

Among the many schemes for access to the sea shore that have been proposed and consummated in San Francisco, the one that promises most, and is nearest, has not until the present time engaged much attention, we mean the projected railway to Bolinas Bay. No city, surrounded by the sea, was ever more isolated from a real attractive beach, than San Francisco, and none are better provided by nature with all facilities. Santa Cruz, a hundred miles away, and Monterey, still farther, are the sea resorts now, while on the north coast, within one and a half hours, or within one hour from the Sausalito ferry, is one of the most attractive shore resorts that can be imagined. Not only this, the course there is around a picturesque mountain, 2,600 feet high, through canyons and redwood forests, alone worth a trip if there were no ocean attractions at the end. There should be no lack of capital to build a railway to Bolinas, as there will be no lack of patronage and earnings when such a road is ready for the public.

A possible new management of the North Pacific Coast Railway, is among the present rumors, and it is quite time. Lying within 30 to 40 minutes of the city, on the Marin Peninsula, is an ideal country of forest, mountain, hill and dale, offering beauties and advantages for country residences that no other city in this country possesses. All that has been wanting to make this available, has been ferry and other conveniences of travel, which thus far has been expanded only as the traffic rendered a necessity, and not even that. The lands nearest the city have been held and sold under circumstances that did not invite buyers, and there is the anomalous circumstance of San Francisco's suburbs extending across the bay to the flat lands, to the leeward, with an impassable esplanade of mud in front. The Marin Peninsula, six to seven hundred feet high, facing to the east and south, a windward shore, and access to mountain, ocean and forest, has been undiscovered as it were, to the present time.

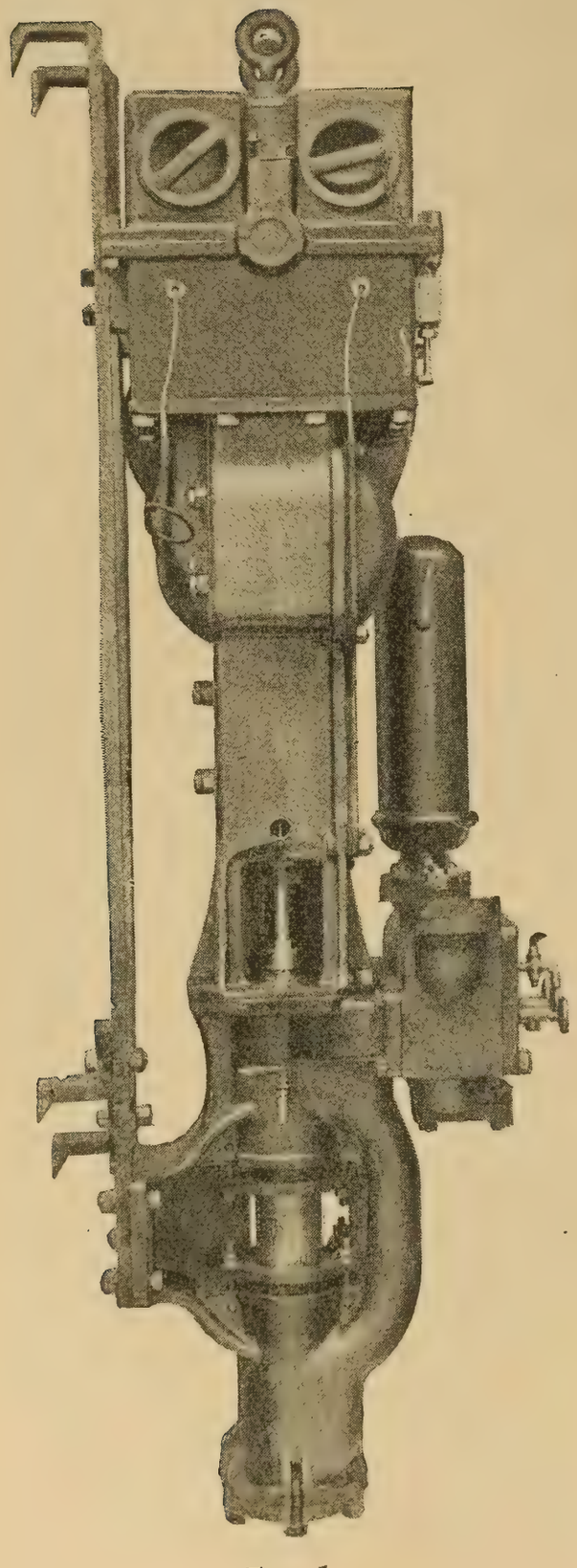


FIG. 1.

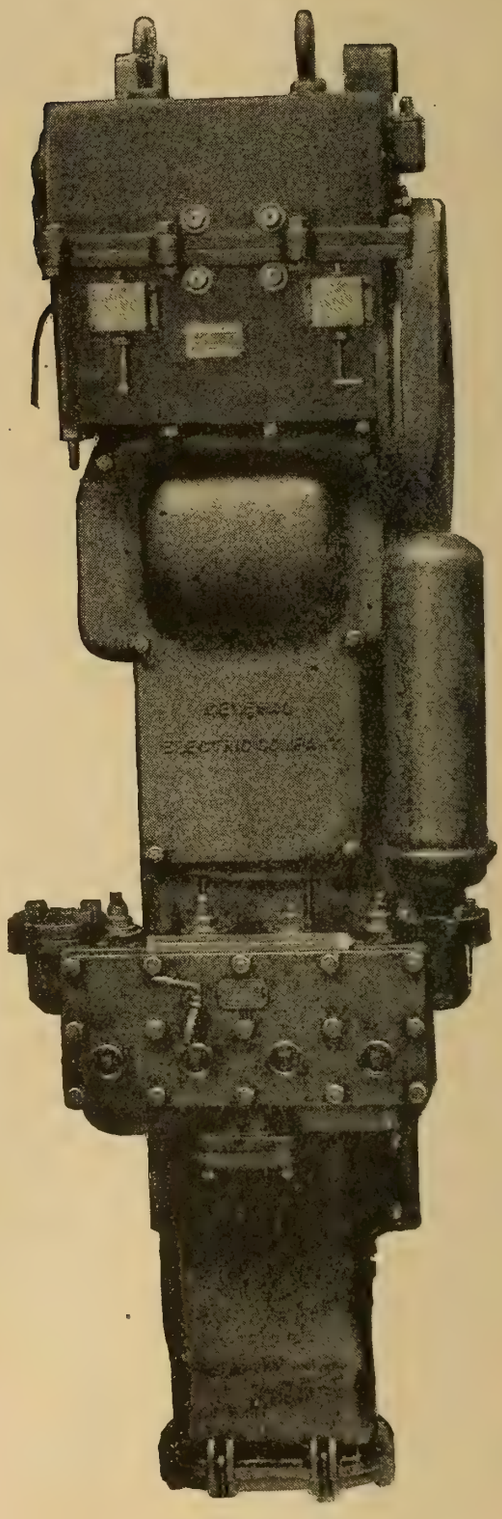


FIG. 2.

DUPLEX ELECTRIC SINKING PUMP.—THE GENERAL ELECTRIC CO.

DUPLEX ELECTRIC SINKING PUMP.

THE GENERAL ELECTRIC COMPANY.

The design opposite is an example of "concentration" that we have never seen exceeded in machine design. The number of elements considered with respect to cubic dimensions, and the further qualification of enclosure for parts that require protection from grit and water, makes up a "study." A rotative engine, with reducing gearing of wide range, cranks, connections, slide glands, and so on, are all included, accessible and protected. The General Electric Company in speaking of these pumps says:

"The difficulties of designing an electric sinking pump, light in weight, compact in form, of good capacity and efficiency, and not liable to damage from moisture or hard usage, have been very successfully overcome in the one illustrated on the page opposite. The electric motor with the gearing and operating mechanism is entirely enclosed in a water-tight, cast-steel casing. The pumps are of the duplex double-acting type with outside packed plungers. The only moving parts visible are short sections of the plungers and rods. All wearing parts are readily accessible for examination, and can be quickly and easily replaced.

This pump is not susceptible to damage from water, and its form is such that it will stand considerable hard usage without injury. It will work as well under water as out of it, in fact rather better, the cooling action of the water increasing the efficiency of the electric motor. If, therefore, the precaution is taken to provide insulated cables for conveying the electric energy to this pump, it may be "drowned" by a sudden rush of water in the mine and still continue operating. Even should the case leak slightly, the motor, being within a waterproof chamber of its own and separated from the gearing, would remain for a long time unaffected.

These pumps are economical in the use of power, and have a very high efficiency. The one shown has a capacity of 125 gallons per minute against a vertical head of 200 feet, occupies a space of only $24'' \times 26'' \times 86''$, and weighs complete, 2,000 pounds. Pumps of this type are made of various sizes, and furnished by the General Electric Company, of Boston and New York."

In the various mining operations to which electrical apparatus has been applied, there is perhaps no other case where the convenience of wire transmission is more marked than in sinking. The pumps operate in the air, so to speak, requiring to be frequently moved, and are often submerged. Steam, air, or mechanical means of transmitting power down a shaft to such pumps, are cumbersome and inconvenient, compared to insulated wires that may be handled like a rope.

NOTES.

"The promise of electrical communication between two distant points without the agency of an intervening wire is being fulfilled with startling rapidity and almost incredible success. The wonderful capacity of the invisible electric energy for leaping across a gulf of air miles in width, and unerringly delivering its message is almost daily enlarging its functions. Inductive electricity, as it is called, which thus finds the atmospheric air, or the ether, a sufficient conductor for its purposes, and was a few years since but little more than a theory of the laboratory and class room, has now become a momentous fact in civilization and commerce. It is only four years since we recorded as a remarkable triumph the feat of telegraphing to and from railway trains in motion by a parallel telegraph line. In this instance, it may be remembered, the electric message jumped across a distance of some twelve feet without any connecting wire, and this achievement on the Lehigh Valley Railway was the theme of considerable jubilation throughout the American continent. Today English electricians at Cardiff and elsewhere are easily transmitting electric messages across a wireless distance of three miles without any sign of approaching the limits of the electric function in this direction."—*Leisure Hours.*

The *Engineering News* publishes the following description of an underground conduit electric railway being experimented with at Washington, D. C.

"The road is laid with 40-pound T rails, yokes of 180 pounds each, and 40-pound slot rails. The conduit, midway between the rails, is 16 inches deep by 17 inches wide, and inside is a loose wire on insulated brackets. This wire is cut in 200 lengths, and carries a current only when the car is moving over one particular section. The copper-feeding cable is laid parallel to the trolley wire. Without going into details, the car is fitted with two ordinary 20 horse power motors, and a pair of trolley wheels passing through the slot connects the motors with the trolley cable. In each 200-foot section is an iron switch box containing an electromagnet, and as the cars enter a section a storage battery of several cells on the car vitalizes the magnet and lifts an iron armature, and connects the trolley and the feed cables and thus supplies power to the motors, while the main line current cuts out the local battery. On reaching the next section the current is again automatically switched on, and is also cut off from the rear section. When the car stops the current is instantly released from the trolley wire, and the same is the case when going down hill. The car can travel in either direction by turning a reversing switch. The cost for a single track is said to be $30,000 per mile."

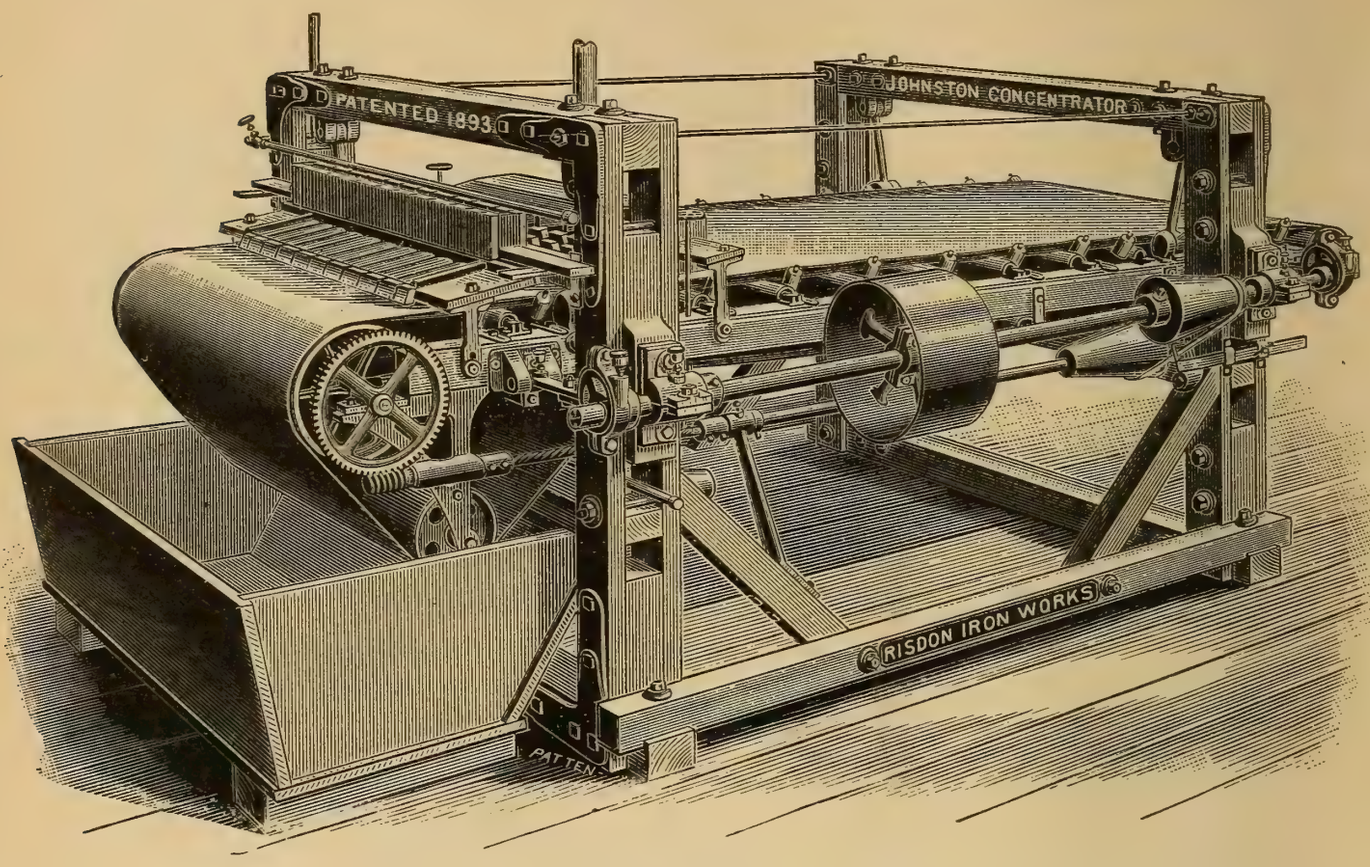
MINING.

NOTES.

The discovery in the Southern States of "Bauxite," the clay or ore from which aluminium is extracted, is, if as now reported, quite a fortunate matter. The name comes from "Baux" in France, where the clay was first or mainly found for a time. This ore is found in Georgia and Alabama, and several carloads a week are now being shipped from Randall, Calhoun Co., Alabama, to a firm near Pittsburgh, where the metal is extracted and manufactured. Hitherto the "Bauxite" for reduction has been imported.

There has been announced an agreement between American and European copper mines to cut down the product so as to maintain prices. This method of business has become so common at the present day that people no longer consider its nature and results. For every one engaged in producing copper there are a thousand who use it, or are interested in its use. There is never too much copper. On the contrary there has never been half enough. It is the base of all the various non-corrosive alloys that enter into industrial uses and might be extended ten fold if the price permitted. Copper or brass is employed whenever it can be afforded. The only limit is its high price. Zinc, tin, lead and iron would give way in many places to copper if the price permitted, so that schemes to keep the price up are a conspiracy against public interest. As to unprofitable mining, that is a myth. The value would always follow the cost of production, and afford a reasonable profit if the price was let alone to settle itself.

The *Mining and Scientific Press*, in a late issue, has a timely article on the establishment here, in San Francisco, of reduction works, which exist at nearly all other large cities west of the Missouri River, and mentions the sending of sulphurets from Grass Valley long distances, even to Portland, Or., for reduction. The freight charges and dear fuel are, as claimed, a main hindrance to industries of this kind here, but not enough under the circumstances to account for reduction being carried on elsewhere on the Coast with success. The way to attract investment to an industry of the kind is to promise a chance of 100 per cent. profit, and one chance in fifty of getting it. This would be an average of two per cent., but the "chance" is the main thing.



JOHNSTON'S IMPROVED CONCENTRATOR.

THE RISDON IRON WORKS, SAN FRANCISCO, CAL.

The concentrating machine shown above is the invention of Mr. Geo. Johnston of this City, who has devoted a great deal of attention to the process of concentration, and was the inventor of the first revolving belt concentrators, with raised edges, and a side-to-side rocking or shaking movement. The first machine of this type was made under a patent granted in 1867 to Mr. Johnston, the inventor of the present machine, and E. G. Smith. This patent was sold to W. B. Frue, and was the progenitor of the numerous machines made under that name during twenty-five years past.

Of the present machine, on which Mr. Johnston has several patents, he says:

"It overcomes all the difficulties and objections to the horizontal shake of the Frue, which piles the sands on the sides of the belt; or to the rocking motion of the Tullock; which throws most of the material to center of the belt.

The belt frame is suspended from four non-parallel hangers set at opposing angles placed in a frame, and by regulating their angle

the oscillation necessary to keep the sides of the belt from being overloaded with sands is obtained, while the oscillation is not sufficient to overload the belt in the center, as is the case with the rocking frames. The result of this motion is a perfect concentrating surface, every portion of which does good work.

The mode of raising the sides of the belt is very simple and effective. Small rollers, at an angle of about forty-five degrees, stand on a slotted base, screwed to the top of the frame, keeping up the sides of the belt to prevent overflow. If the belt shifts to either side it can be followed up by the rollers, and answers all the purpose of moulded edges, which are expensive and short lived.

The pulp box discharges the pulp in narrow channels four inches apart in the direction of the belt's travel, and as close to it as possible, leaving spaces on the belt where the sulphurets can remain undisturbed by the fall of the water or sand, and pass up to the clear water at the head of the belt, the sands at the same time passing down in the same channels without obstruction to the foot of the belt.

The clear water is distributed in the same way. From the usual water box it falls on a board containing grooves corresponding with the sand box. This board is made fast to the shaking frame, and the water falls on the same portion of the belt on which the pulp fell with very little splash, leaving a large portion of the surface where the sulphurets have an uninterrupted upward travel, and the sands are not disturbed by the fall of sand or water on their passage down.

This concentrator is simple in construction, and easily managed, anyone can learn to run it in a few hours. It will do the work of five stamps, and extract more value than any other machine in use."

Mr. Johnston also sends the following data from some experiments made with these new machines at the St. Lawrence Mine, Ophir, Placer County.

"Assay of slimes, drippings from the belt when there was not sufficient wash water on the under side of the belt:

Gold, $2.43; silver, 68 ounces per ton. A good deal of galina in the ore.

Tailings, 10,000 grains:

2,592 grains passed through 100 mesh screen. No sulphurets.
1,580 " " " 80 " " " "
1,738 " " " 60 " " " "
2,592 " " " 40 " " } 4 grains of sulphurets
1,495 grains would not pass through 40 mesh screen. } in cubes and flakes.

The quartz was crushed through a No. 8 slotted screen in a 3½-foot Huntington mill."

The "concentration" of minerals, which means selection or separation, has been a fruitful field for invention, depending, as it

does, upon conditions of saturation, agitation, affinity and mechanical cohesion, also, perhaps, to magnetic and chemical action, all of which are obscure, and can not be definitely arrived at by inference, indication or analogy.

The processes have been developed tentatively, and evolved from that most flexible of all implements, the "batea," the use of which is a continuous experiment, so to speak, conducted by observation as the process goes on. It is true the manipulation of the batea has assumed a conventional form or motion, which can at once be detected but not described. Concentration is much the same, it is a work of evolution, and study of the subject consists mainly in searching for explanations of observed results.

There is, no doubt, a time approaching when the best movement and inclination of the surfaces, the best method of feeding and distributing, with other conditions, will be known, but that time has not arrived. There is a great deal yet to be done, and much to be learned, and a good deal to be unlearned.

The mining engineers of this country have, no doubt, the foremost place in the art of fine concentration, although accounts some times reach us of wonderful machines invented elsewhere. The present machine seems a refinement in various respects, and is "conservative" in its design and claims.

These machines are made and furnished by the Risdon Iron Works in this City.

THE SUNSET IRRIGATION WORKS.

The Sunset Irrigation District of Fresno County, have completed plans and awarded contracts for the construction of a large irrigation plant involving a system of water-raising machinery of a very extensive kind.

At a meeting of the board of directors of the company, held at Selma, on the 20th of April, there was received a tender for the bonds to cover this work, amounting to $1,680,000, at a discount of ten per cent. The offer came from Mr. J. A. Barclay, London, England, and was accepted, the purchaser reserving the privilege of having expert examinations, to be made as to the legal and engineering points involved in the undertaking.

The water is taken out of Kings River and carried across a valley between embankments, serving by gravity a large area of

country. In addition to this, it is proposed to raise by means of turbine water wheels and centrifugal pumps, a portion of the water to two higher levels, 21½ and 41½ feet respectively, operating through pipes some of which are of 96 inches bore, in one case 22,000 feet, and in the other 34,000 feet, or in all, over ten miles of pipes.

The plant will consist of ten pairs of water wheels aggregating 2,280 horse power, driving an equal number of centrifugal pumps, each of 24-inch bore, the aggregate capacity of which will be from 30 to 40 thousand gallons per minute for the lower level, and proportionately less for so much as is elevated to the higher level.

To accommodate the pumps to these two different heads, which are very nearly as two to one, a part of the pumps are "compounded," that is, one pump discharging into another, so the duty is divided between the two.

The whole works have been designed by Mr. John S. Eastwood, C. E., of Fresno, Cal., the engineer in charge, and the centrifugal pumps, by Mr. John Richards, of San Francisco, to meet the plans and data laid down by Mr. Eastwood. These pumps have some features of novelty that are expected to give a high efficiency in working. The wheels or runners are of the open type, with a curved diaphragm or plate, that divides the water into two equal parts, and balances the pumps, so the water is taken in at one side, thereby avoiding angles and resistance, due to a double or forked suction inlet, permitting a cheaper and more simple arrangement of the ponderous pipes.

The water ducts through the pump are more nearly of uniform section than in any example that can be referred to, and the curves are all of long radius and symmetrical. The construction of the whole of the works has been let to the Portland Construction Company, of Portland, Oregon, for the sum of $1,380,000. This will, no doubt, be the most extensive water-raising plant in the world. Mr. Eastwood has shown a high degree of professional skill in preparing the plans, reducing a former estimate of $5,000,000 down to $2,000,000, and improving the scheme at the same time.

TECHNICAL SOCIETY OF THE PACIFIC COAST.

This association held their regular monthly meeting on the 5th of May at their hall in the Academy of Sciences Building. The following new members were elected :

Curtis M. Barker, Civil Engineer.....Mayfield, Cal.
Geo. C. Power, Civil Engineer.....San Buenaventura, Cal.
Valentine J. Rowan, Civil Engineer.....Los Angeles, Cal.

One new name was presented for membership.

Mr. W. F. C. Hasson presented and read a paper on the "Electric Transmission of Power Long Distances," which was discussed by a number of the members. Mr. Ernest McCullough read a paper on the subject of "Photographic Topography," relating to the employment of a camera in preparing maps, which is reprinted in our present issue.

A special meeting in conjunction with the California Medical Society, was appointed for the 19th of May. This meeting is noticed below.

Mr. Adolph Sutro, having for a second time extended an invitation to the members of the Society to visit his grounds and works at Sutro Heights, the invitation was accepted for the 13th of May, at which time, thirty or more of the members attended, and were shown over the great bath building and other works that have made a good deal of progress in the past year, or since the former visit of the Society. A fine luncheon was served and appropriate remarks followed, in which the President and others acknowledged the courtesy of Mr. Sutro, who is an honorary member of the Society. The meeting adjourned at 4 P. M. and returned to the city.

These visits to Sutro Heights are a most enjoyable affair. The munificent works most of them of a public nature, or for public use and enjoyment, include a good deal that comes within the Society's province to consider.

The engineering features which specially interest Mr. Sutro himself, are of an unique character. The method of heating the swimming pools by jets of steam, causing at the same time a rapid circulation of the water, is a new feature in such plants, also the method of catchment for sea water, which performs its own dynamical work, the waves being caught in a pool as they rush up the face of the cliff, and then run off in a canal to the baths. The work is a

stupendous one of the kind, and has been planned as well as the construction directed, by Mr. Sutro himself, with like vigor, but under different circumstances than those with which he prosecuted his famous tunnel under Mount Davidson.

The joint meeting of the Technical Society and the San Francisco County Medical Society was held in the main hall of the Academy of Sciences, on the evening of May 19th. The meeting was called to order by President Grunsky, who stated that the subject of the evening would be open for discussion from a medical as well as from a technical standpoint, and that anyone present might participate.

Mr. Marsden Manson read a paper entitled: "Are California Homes as Healthful as they should be?"

Dr. J. H. Stallard, of the San Francisco Polyclinic, followed the speaker, extending his remarks to the condition of the San Francisco sewer system in particular, and dwelling upon the necessity of improvements; claiming that two thousand deaths annually are due to the defective sewers, and to other causes that proper sanitation may remove.

The discussion of this important subject was continued by a number of others, touching upon the numerous points involved in the question of municipal sanitation.

At the next regular meeting of the Technical Society, June 2nd, Mr. J. Richards will read a paper on "Modern Methods of Pumping Fluids." This paper will no doubt call out a good deal of discussion, much needed at this time. There are signs of wide changes and improvements in this important class of machines.

RECIPROCITY AND RETALIATION.

This Journal has from the beginning of the scheme contended that trade reciprocity in the sense of modifying tariffs with particular countries would result in no good, favoring as it does only certain interests and firms trading to these countries. It was, to begin with, a sophistical method of removing trade restrictions by which this country could gain no advantage, and now, after some experience in reciprocity, such a result is apparent. In the case of Brazil, for example, we were expected to gain a great deal. The evils of our trade there we are told, was a balance against this country, that is, we bought more than we sold, sending out more money than we

received back from that country. This balance "against us," as it is called, amounted to from 50 to 75 millions a year.

Under the reciprocity treaty, Brazil, during the first year has bought from us $171,627 worth of goods more than for the year preceding, and has sold us during the same time $104,341,731 more than she bought, an increase of $35,231,382. In other countries where retaliation has been tried, Colombia, Venezuela and Hayti, the increased taxes on their products cost us about $5,000,000 a year, but have no effect on the countries punished by retaliation. This is worse than childish. It is that, and a great commercial loss besides.

Statistics given out by the Treasury Department since the above was written, show that in fourteen months past, our exports to Germany have fallen off over five millions, and there is a balance to be settled in gold, of $3,517,296 greater than in the fourteen months preceding. In Brazil an adverse balance of $127,634,000 has been raised to $232,734,000, showing a difference of $105,000,000, and enough, with other cases to more than account for the drain of gold out of the country, of which we have heard so much. In all the reciprocity countries taken together, there has been an increase in adverse balance of trade of more than $125,000,000, to be settled in gold instead of goods. It is true the goods sold might be worth more to us than gold, but just now we have more goods and less gold than we require.

SIBERIAN RAILWAY.

There has been recently made a railway survey that will possibly become the most remarkable one ever laid down. We mean from Vancouver, B. C., to Cape Prince of Wales, Alaska. The dream of a railway to Europe every year puts on more the face of a reality, and it would be a bold prediction now to pronounce it either impossible or improbable.

The main difficulty is removing itself at a rapid rate, indeed the most difficult part will, no doubt, be the first accomplished, we mean the way across Russian Siberia. This great undertaking is moving on with its southward branch toward the Sea of Japan, and when completed to Vladvistock will be within one thousand miles of this continent. The natural impediments to be overcome are appalling, but are not impossible, and when we consider the enormous objects in view, nothing but impossibility can prevent consummation.

It has been pointed out that the want of business along a line four thousand miles long, and the severity of the climate will confine a railway route to through business, and to the summer months, and these are certainly formidable and undeniable impediments, but the countervailing advantages of a land route, and the rapid development of these northern regions, must at the same time be taken into account.

If the resources of the Russian Government will carry the Siberian Railway to Behring Straits it will be met on this side with equal enterprise. The survey at first named must have some such object in view, and people living now may see the time when trains will leave San Francisco for Vienna, Berlin and Paris, via Alaska and Siberia.

NEW LAKE STEAMERS.

The Globe Iron works at Cleveland, Ohio, have under construction, two steamers for service between Buffalo and Duluth, that will rival all but the largest deep-water vessels. These ships will cost $600,000, have quadruple expansion engines, 25, 36, 51½ and 74 inches diameter, of 7,000 horse power ; all valves of the piston type. The length is 380 feet, beam 44 feet, depth 34 feet. The most novel part of the whole will be the boilers, of the Belleville type, twenty-eight in number. These boilers are of the water-tube kind, and have been very successfully employed in French war steamers, also for merchant service. The Belleville boilers were extensively advertised all over the world, about fifteen years ago, as "inexplosive," and it is fair to suppose the maker has, in all this time, brought them to a high state of perfection. The development of high class ship-building on the Lakes shows what American builders can do when they have a chance. The same thing will occur in deep-water service when the navigation laws are repealed and material is available at natural prices. The *Marine Review*, Cleveland, points out that these steamers are to form a link in a transportation system between the Atlantic seaboard and Puget Sound, by the Northern Pacific Railway line, and in competition with the Canadian Pacific Railway for trans-continental and Oriental trade.

This looks a good deal more patriotic and public spirited than railing at the Canadian line because of its inroads on American commerce. The only way to compete at this day is to excel, and

there would be a good deal more excelling done, if it were not for the pernicious system of artificial and subsidizing methods. When our trans-continental facilities, under milder climate, better grades, and shorter routes, cannot compete with the Canadian line, it is time to hand the business over. The great subsidy to the Canadian company is no more, all circumstances considered, than has been enjoyed by our own lines across the continent.

THE NIAGARA FALLS TURBINES.

The following communication was published in the *Engineering News* of April 6th last, and is so nearly in the line of some previous criticisms in this Journal that we reproduce it for our readers:

"Sir: It does, indeed, seem rather a pity that when the greatest hydraulic power plant ever undertaken is carried out in this country, the designs and working drawings for the machinery should be made by foreign engineers.

For all ordinary water powers American turbines long ago proved their practical superiority to the best work of foreign engineers, and it is rather surprising that the turbines for this plant of world-wide fame should have to be designed by a firm of Swiss engineers. However, as only two out of the fourteen designs which were submitted to the International Commission were prepared by American firms, it is not quite fair to conclude that no American engineer has the ability to cope with such a problem as that at Niagara Falls. It may be that the American engineers, who should have done as good or better work than Messrs. Faesch & Piccard, are too busy to enter competitions; or, perhaps, they took it for granted that the simple and efficient Pelton wheel, which has proven its value so thoroughly under exactly the conditions presented at Niagara, would have so great practical advantages that no form of turbine would stand any show. Whatever the reason may be, our hydraulic engineers of greatest experience and ability made no attempt to solve the Niagara problem; the International Commission, or the Cataract Construction Co., were inclined to look rather doubtfully on the Pelton wheel, and so the designs of a Swiss firm were accepted.

The drawings of the Swiss turbines, which you published in your issue of March 30th, show many commendable features; and yet I must confess that I find them somewhat disappointing, perhaps because I was expecting that some remarkably perfect machines would be the result of that international competition. I have understood that the Pelton Wheel Company offered to guarantee an 80

per cent. efficiency for their wheel, and its advantages of simplicity, accessibility, ease of repair and small first cost are generally admitted. So when it was stated that a Swiss turbine had been chosen instead, I supposed that it must possess marked advantages, and be a decided departure from any turbine in existance. Thus, you see, I was prepared to give Messrs. Faesch & Piccard full credit for all the ingenuity and engineering ability displayed in their designs, and I do this with pleasure. Certainly their turbine is the work of no 'prentice hand. At the same time I wish to exercise the right of every free American to find fault. I am disappointed, in the first place, with their arrangements for securing efficiency. When the Pelton wheel, with its probable efficiency of at least 80 per cent., was discarded I supposed some motor with at least 85 per cent. efficiency would be chosen in its place, but as near as one can judge from Messrs. Faesch & Piccard's drawings, 80 per cent. at full load will be as good an efficiency as can possibly be expected, and very much less than this at the ordinary load of, say, 75 per cent. The plan adopted by Messrs. Faesch & Piccard of increasing the efficiency at partial loads by dividing the turbine horizontally, so that the one wheel becomes practically three wheels, is an ingenious one, but why did not its author carry it farther? As now arranged the turbine will work at the best efficiency when it has either full load, two thirds load, or one third load. It seems reasonable to believe, from what is now known, that these turbines will usually be run at about three fourths load, and will be run but little at less than 40 per cent. of their rated load. Thus, to secure the greatest efficiency in these turbines the wheels should not be divided into three equal parts, but in the proportions of, say, 40, 40 and 20. Then, under ordinary loads the water would escape freely from two sets of openings larger than those in the other wheel, and so having less frictional loss.

The method of regulation adopted, throttling escaping water, has the advantage of simplicity, but is, of course, a wasteful system. It seems as if some system of regulation by adjusting the guide passages, not too complicated to be practicable, might have been devised. Apparently the designers have sacrificed efficiency wherever necessary to obtain close regulation of speed, but notwithstanding this the rate of regulation, which it is claimed will be secured, seems to me disappointingly sluggish. If only 25 per cent. fall in the load causes a 3 per cent. or 4 per cent. jump in the speed, there is certainly considerable to be desired in the governor and its appendages.

For these reasons, and others which I will not take your space to state, I am disposed to believe that some American engineers, if they had chosen to attempt the task, could have designed turbines quite as good as those of Messrs. Faesch & Piccard.

"HYDRAULIC."

New York, April 3, 1893.

MUNICIPAL GOVERNMENT IN BERLIN.

In Berlin, Germany, all buildings must be erected under Government inspection, and the plans for structures of all kinds must be submitted and approved. In building no litter is permitted in the street. Materials of all kinds must be kept within the limits of the private ground. The sidewalks must be protected by a roof as soon as the second story is reached. Mortar is prepared, and sold as a commodity, and not mixed on the ground.

The city, instead of continually increasing her debts, makes a profit of more than a million of dollars each year. Each corner of the streets have ornamental lamp posts with four burners and reflectors, and the city is lighted three-fold better than any are in this country.

The city government insures all buildings, and pays for them if burned, the control of construction and insurance going together as it ought to. This insurance business is conducted as a separate department, that issues stock to cover the capital employed.

The streets are so clean that the American Consul, to illustrate the matter, says one may drop a handkerchief anywhere, and not soil it. The city owns farms where the sweepings of the streets are scattered for manure by paupers. The sewage is pumped out and similarly applied.

The streets are swept by a brigade of boys, always on duty, and who have grades and promotion. The buildings are also kept clear, and no posters are permitted on walls. Octagonal iron cylinders, fifteen feet high, are set up at particular places for this purpose. These belong to a company who rent the space. On the top of these pillars are clocks showing the correct time, and reflected lights show the advertisements at night the same as in the day. There are also railway time tables, and indications of temperature and barometic pressure on these pillars.

Taxes are assessed on income, and this, as in England, is rated on the rental, which is, perhaps, the best clue to income. It is commonly rated at three times the amount of rent. All incomes over $105 a year are taxed.

There is an intelligence office where one can go and find the address of any person in the city. The eye of the Government is on everyone and everything, as it ought to be, and is for the good and protection of people who obey the laws and attend only to their own business.

MACHINE KEYS.*

BY J. RICHARDS, IN CASSIER'S MAGAZINE

There appears at intervals, usually of three or four years, a series of essays and letters in technical journals respecting machine keys, often accompanied by rules or formulæ for proportions and analysis of the strains or pressure on key surfaces and the seats in which they fit.

This literature does not seem to have much effect on practice, and this is not to be wondered at, because in nearly all cases, and indeed all of recent date we have seen, the subject is treated "generally," and without recognition of the fact that there are two kinds or systems of keys, both proper and necessary, but widely different in nature, and it may be suggested that a failure to make this distinction is a main cause of divergent opinions and practice.

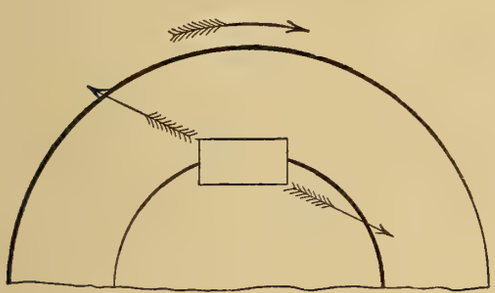


FIG. 1.

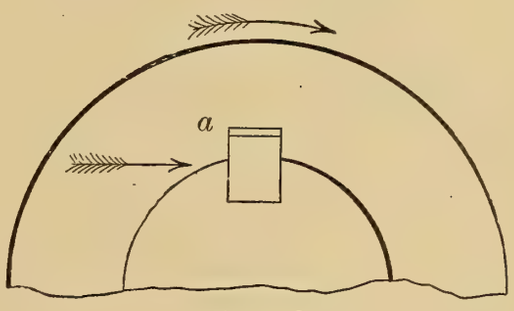


FIG. 2.

The two kinds of keys referred to are illustrated in the diagrams Figures 1 and 2. Fig. 1 shows the common fastening key, usually made in width one fourth of the shafts diameter, and the depth five eighths to two thirds the width. These keys are tapered and fit on all sides, or, as it is commonly described, "bear all over." They perform the double function in most cases of driving or transmitting and fastening the keyed-on member against movement endwise on the shaft. Such keys, when properly made, drive as a strut, diagonally from corner to corner, in the direction indicated by the arrows, a fact not always considered or understood by those who fit them.

The other kind or class of keys, shown in Fig. 2, are not tapered and fit on their sides only, a slight clearance being left on the back at *a* to insure against wedge action or radial strain. These keys drive by shearing strain as indicated by the arrow, and consequently in a totally different manner from those shown in Fig. 1. For fixed

*Copyright by the Cassier Magazine Co.

work where there is no sliding movement such keys are commonly made of square section, the sides only being planed, so the depth is more than the width by so much as is cut away in finishing or fitting, as shown in Table II.

For sliding bearings, as in the case of drilling-machine spindles, the depth should be increased, and in cases where there is heavy strain there should be two keys or feathers instead of one.

It was the intention at first to confine the present remarks to the application or use of these different kinds of keys, but as the question of proportions will be involved, the following tables for dimensions will be of use for reference. They are taken from proportions adopted in practical use, and expressed in parts of an inch for convenience.

I.

DIMENSIONS OF FLAT KEYS, IN INCHES.

Diam. of Shaft	1	1¼	1½	1¾	2	2½	3	3½	4	5	6	7	8
Breadth of Keys	¼	5/16	⅜	7/16	½	⅝	¾	⅞	1	1⅛	1⅜	1½	1¾
Depth of Keys	5/32	3/16	¼	9/32	5/16	⅜	7/16	½	⅝	11/16	13/16	⅞	1

II.

DIMENSIONS OF SQUARE KEYS, IN INCHES.

Diam. of Shaft	1	1¼	1½	1¾	2	2½	3	3½	4
Breadth of Keys	5/32	7/32	9/32	11/32	13/32	15/32	17/32	9/16	11/16
Depth of Keys	3/16	¼	5/16	⅜	7/16	½	9/16	⅝	¾

III.

DIMENSIONS OF SLIDING FEATHER KEYS, IN INCHES.

Diameter of Shaft	1¼	1½	1¾	2	2¼	2½	3	3½	4	4½
Breadth of Keys	¼	¼	5/16	5/16	⅜	⅜	½	9/16	9/16	⅝
Depth of Keys	⅜	⅜	7/16	7/16	½	½	⅝	¾	¾	⅞

Referring now to use, flat keys, as in Fig. 1, are employed for fixed work when, as before explained, the parts are to be held not only against torsional strain but also against movement endwise, and in case of heavy strain, the strut principle being the strongest and

most secure against movement when there is strain each way, as in the case of engine cranks and first movers generally. The objections to the system for general use are, straining the work out of truth, the care and expense required in fitting, and destroying the evidence of good or bad fitting of the keyed joint. These objections are, of course, not to be considered when such keys are required, but only in respect to limits of their application.

When a wheel or other part is fastened with a tapering key of this kind there is no means of knowing whether the work is well fitted or not. The wedging action on the back of the key holds all firm, and the only evidence of bad fitting is in a want of truth in the movement of the member keyed on. For this reason such keys are not employed by machine-tool makers, or in the case of accurate work of any kind, indeed cannot be, because of the wedging strain, and also the difficulty of inspecting completed work. In the Industrial Works at Philadelphia, now Bement, Miles & Co., it was the custom formerly, and may be now, for the inspector to insert a thin strip of metal on the back of the key at *a*, Fig. 2, to see if there was a bearing there so as to hide bad fitting. If there was no bearing then the work could be started off or sidewise with a blow, unless it was a "pressed on" joint. In that case there was always other evidence to show the fit. The same rule applies in England to general practice, especially to machine tools and similar work, and, as explained, is a necessity in successful inspection, as well as in all cases where parts have to be removed or interchanged, like the train wheels of engine lathes.

In miscellaneous practice it is easy to see that two kinds of keys are required, and any useful dissertation on the subject must recognize and embrace this fact. In some cases flat keying will be most required, in steam engine making and mill gearing for example. In other cases where the lighter class of machinery is made, nine tenths of the keys should be of the shearing class, shown in Fig. 2, and are so made.

Compression couplings of all kinds are fastened by this kind of keys, and must be. A wedge key bearing radially would be a contradiction of the clamping feature of such couplings. On the contrary, flange couplings are fastened with flat or strut keys to hold against end movement.

Sliding keys, called sometimes "feathers" or "splines," such as are moved under strain, require more bearing surface or depth as given in Table III. Such surface can be gained by length

in most cases, or by two keys, one on each side, which is preferable because of dividing the torsional strain, and preventing wear of the main bearings on one side. It is only recommending good practice to claim that every traversing spindle or shaft operating under strain should have two keys or feathers. The extra cost is not much, and the advantages are obvious, especially for screw cutting and boring spindles of machine tools.

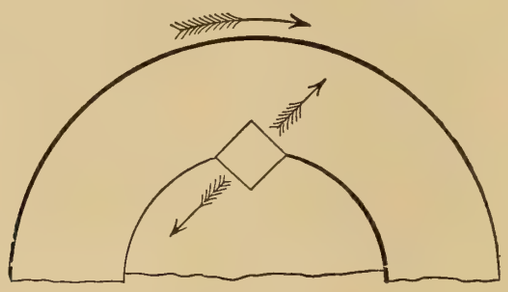


FIG. 3.

These remarks are called out at this time by observing some articles on the subject in several technical journals, and especially by noting in a drawing of the Ball & Wood steam engines, keys as shown in Fig. 3. This seems a novel method, and is certainly one that has claims in respect to adaptation and economy for fixed joints. The key drives as a strut, in the manner indicated by the arrows, and certainly seems an improvement on the flat key system. The bearing surfaces in proportion to cross section are increased. Key-ways of moderate size for shafts, four inches or less in diameter, can be made at a single cut with milling cutters or gauge tools ground to an angle of 45 degrees, or for larger keys by planing to the same angle each way, the only care required being to attain a definite width at the top or surface. Cutting in these angular grooves is much more free than in planing out rectangular ones, and there is not that unavoidable wear of the "corners" of the tools, be they for planing or milling. There is an impediment in the way of taper, when required, but we imagine that with keys of the kind, taper can be dispensed with if the fitting is well done.

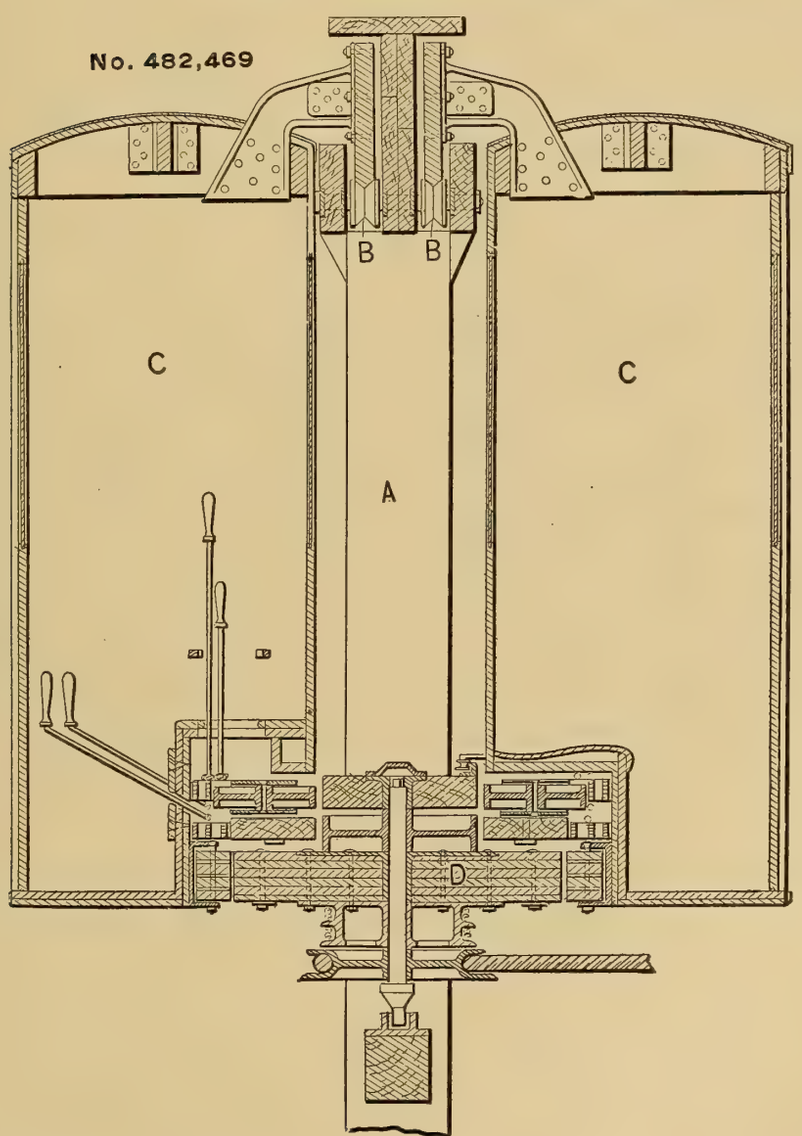
NOTES ON NEW AND PATENTED INVENTIONS.*

BY J. RICHARDS, IN CASSIER'S MAGAZINE

No. IV.

U. S. Patent No. 482,469, Sept. 13, 1892.

L. F. Cook.—Transportation System.



In this invention it is proposed to suspend railway carriages from the top, at one side, so they will bear laterally at the bottom against drums or friction wheels set along the permanent way at intervals less than the length of the cars. There are to be two sets of cars,

*Copyright by the Cassier Magazine Co.

one on each side of the supporting structure, the distance between them spanned by the friction drums, so the traffic is driven each way by the same drums.

In the diagram, *A* is one of a series of posts or pillars for the permanent way, *B* supporting rollers on which the cars *C C* are suspended at the sides, and *D* one of the friction drums between. Other details do not require explanation here, as the purpose is not to consider this particular invention so much as making it a text for some remarks upon the frictional element involved, and some other methods for propelling railway traffic.

Frictional apparatus of all kinds is the *bete noir* of mechanics. Its success in the case of driving bands has led to all kinds of expedients for introducing it into machines, successful and indispensable in many cases, unnecessary and a failure in still more cases. The method involves so many vague factors and conditions that it is not always easy to determine beforehand whether friction or traction is suitable or not.

The limitations as to endurance are the extent and velocity of movement that takes place between the surfaces in contact and the pressure, or pressure divided by area. The ascertained data need not be discussed here, it is available elsewhere and is much easier to follow out and understand than the phenomena that arise in various examples of application.

Such apparatus can be divided into two classes. One wherein contact is theoretically but a line, as when both surfaces are convexed or curved, or one is curved and the other a plane. The other class where the faces in contact are parallel, or, as we may say, fit together. In the first class, most extensive of all, is railway traction by locomotives, by frictional adhesion of their wheels, that equaling from 20 to 30 per cent of the weight or the pressure.

This is a peculiar case, without parallel in machine work, or machine uses of frictional methods. The contact is that of a circle meeting a plane in two directions, the curved wheel and flat rail in one plane, and the curve on top of the rail meeting a plane across the face of the wheel the other way, an arrangement no one would think of adopting in designing frictional gearing. Another peculiarity and cause of high tractive force, is in the pressure being produced by gravity, hence certain, uniform and measurable, never relaxing, and free from all the operative contingencies that attend upon springs or other devices to press the surfaces together.

Cable traction for railways is another peculiar application of the

friction method, varying in several respects from common friction gearing. In no other case is there so much sliding of the bearing surfaces, a result caused by the weight and inertia of the mass to be put in motion, and the frequent stops and starts, also the sliding that takes place when the cars are moved at a slower rate than the cable.

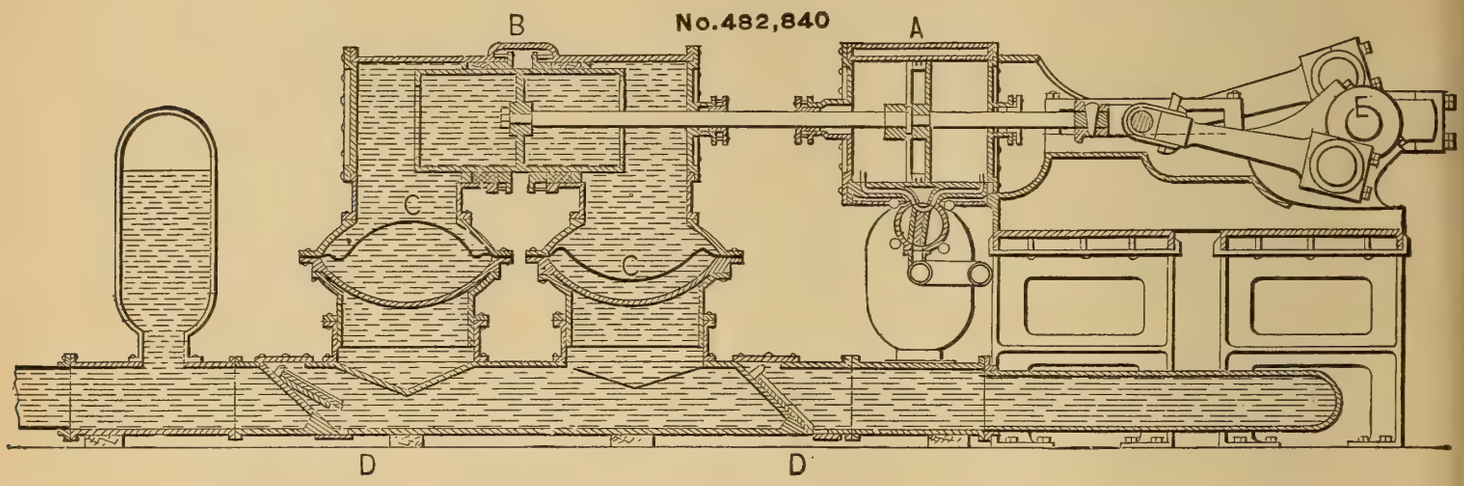
To offset this sliding and consequent wear of the surfaces there is fortunately an enormous amount of surface to withstand wear. A cable two miles in length has from 3,000 to 4,000 square feet of surface, and notwithstanding the very adverse circumstances of use, such as rough surfaces covered with grit and dust, the endurance bears a fair proportion to the area of contact. The shoes or clamps that bear upon the cable are destroyed at a rapid rate, but these are quickly replaced. The life of a cable under ordinary use can be set at a year and a half, and the wear of clamps at one pound of iron ground away for every ten miles of service. The bearing area is from 15 to 30 inches of parallel surface, but not acting in the manner of planes, because the impingement is in one direction only, and the effective surface not more than one half the area in contact.

It will not be necessary to consider other cases of frictional traction to arrive at some conclusion respecting the probable result of driving a car by means of a third or fourth of its weight bearing against friction wheels, to say nothing of the maintenance of driving drums throughout a line at intervals of less than the length of a car. Without computation we imagine the axle and rolling friction could not be provided for in this manner, even on a level grade.

U. S. Patent No. 482,840, Sept. 20, 1892.

C. H. Booth.—Steam Pump.

This patent relates to dredging or sludge pumps for raising and conveying material, such as will wear or foul the pistons and valves, and consists in interposing between the pistons and the liquid or material to be pumped, flexible diaphragms, the pulsations of which coincide with the movement and displacement of the pump pistons. In other words, the water in the pumps is retained there, and the pulsating diaphragm below the pump becomes in effect a second piston, acting on and impelling the material to be pumped.



The drawing above will very clearly indicate the method of operating and the construction of one pump and engine, there being three set side by side, so their united action will produce a continuous flow in the discharge and suction pipes, both of which are common to all of the pumps.

A is the steam engine, *B* the pump, and *C C* the flexible diaphragm, one being shown on the inward and the other on the outward stroke. *D D* are valves, and *E*, a three-throw crank shaft to regulate the stroke and maintain the proper relation and movement of the three engines and pumps.

The scheme is novel, and in pumping sand the machinery would be protected from wear, or as we may say destruction, because no piston pump can last but a short time with sand passing through it, but there is a question of the expediency in employing such pumps for this kind of duty, not only in respect to their endurance but also first cost and efficiency. The principal thing of all is, however, whether the flexible diaphragms can be maintained at reasonable expense, especially in dredging, where there is stone, or as in harbors everywhere, a miscellaneous assortment of scrap iron to be passed through pumps. In a recent case a fifty-pound Dahlgren shell came through a dredging pump at Honolulu.

Dredging pumps are what may be called an undeveloped branch of machinery at this time, and experience goes to show that in pumping sludge or sand, especially the latter, an intermittent flow, such as is unavoidable with crank motion, is not suitable, because of the period of rest permitting precipitation. Precipitation means clogging in the case of drift sand or fine sand. A deposit of this in the pipes or water chambers is hard to remove by a current.

The finer the sand the harder the deposit. In the case of very fine sand that has been deposited by wind, such as is common along the Pacific Coast, where the prevailing winds are "on shore," it will sometimes "build in" a vertical pipe forming an annular stratum closing the bore until the flow is stopped. This is an extraordinary result, one that can be prevented, however, by a rotation of the water in the pipes, produced by some kind of spiral deflecting apparatus.

We speak of sand especially, because it is the most difficult to handle. Silt, clay, or indeed any material soluble, or light enough to be easily maintained in suspension, offers no difficulty in pumping by centrifugal machinery in which no valves are employed and the flow is regular. As to valves, such as are necessary in piston pumps, and especially pumps driven by cranks, which require that the valves close at each stroke, we must express doubt as to their successful working in such material, no matter what the form of the valves may be.

Weight for weight, and cost for cost, there is no doubt that the cost of centrifugal pumping apparatus for dredging, has double the capacity possible by any other system to deposit the "spoil" on the shore, or at a distance. In fact, the pumping part is one of minor importance compared to either getting the material into the pump, or from the pump to the place of deposit. Securing the spoil is the most difficult part. An experienced man, who has been engaged for a number of years in operating dredging pumps, recently remarked; "After I get the material into the suction pipe there is no further difficulty, the real problem lies beyond that point." Included in "securing" the spoil, is the movement or adjustment of the apparatus employed. This is commonly supported on a swinging boom or frame, that with the pontoon or barge on which all is mounted, turns on a pivotal point, advancing at each stroke or cut, by means of extensive and complicated tackle, so that dredging by pumping, is hardly a problem of pumps, or at least the pumps are not the most difficult portion to maintain.

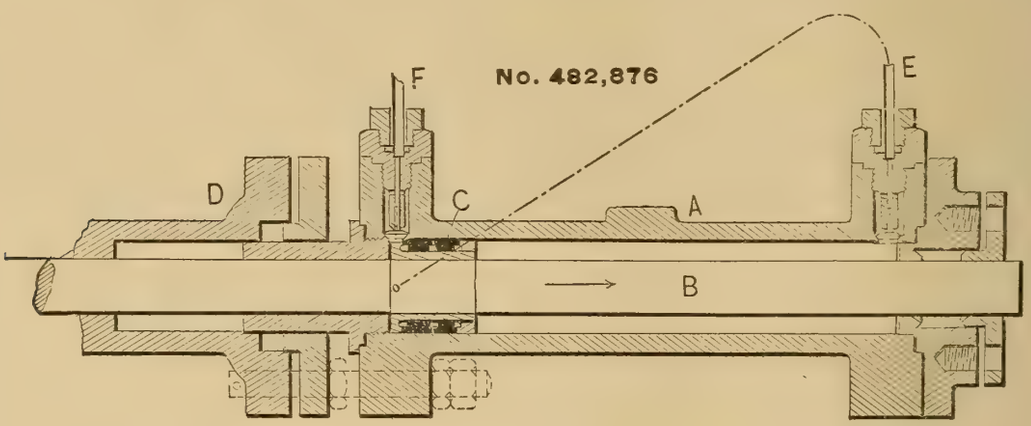
U. S. Patent No. 482,876 September 20, 1892.

Bernhard H. Munsch.—Gas Compressor.

This invention comes from Hastedt, Germany. Its purpose is to save and return any gas that may escape around the piston rods of

compressing pumps for air, ammonia, or other volatile fluids dealt with.

The invention consists of an auxiliary pump barrel *A* around the piston rod *B*, having a close fitting piston head *C*. Any gas escaping through the main gland *D*, passes into the pump barrel *A*, and is expelled at *E* by the outward stroke of the piston *C*, and



BERNHARD H. MUNSCH.—GAS COMPRESSOR.

any gas leaking a second time past this piston, is expelled at *F* and conducted from there to the inner end of the barrel *A*, to be forced out through the discharge *E* leading to the suction or inlet of the main pump or compressor. It is in substance, a second air pump to take up and return any gas leaking around the piston rod of the main compressor.

This invention we do not notice with respect to its mechanical features, so much as one presenting a good subject on which to form an "economic equation" in which the amount or value of the gas that escapes around a piston rod with common packing, should equal the extra cost, room occupied, and maintenance of the added devices involved in the invention. Every new invention can with more or less certainty be reduced to a commercial problem by setting on one side the value of the functions gained, and on the other side the cost of providing and maintaining new apparatus directed to these functions. In some cases, but not many, the functions are increased or improved and at the same time the agent or means is simplified and cheapened. Such inventions are the most valuable and exceed the rule once before laid down in these notes, that in order to succeed commercially, a new invention must produce better results at the same cost, or the same results at less cost.

In the present case, it is assumed that there is a certain quantity of gas escapes around the piston rods of the compressing engines or

pumps, that this gas has a certain value in excess of the first cost, room required, and maintenance of the invention; also, that the present means is the best yet devised to prevent such loss. These are the obvious assumptions on which the patent is based, and by their truth or fallacy must be determined its value. Practically, the piston rod *B* must be made enough longer to receive the auxiliary pump, which having the same stroke as the main one, doubles the working length of the piston rod, adding nearly a stroke and a half to the length of the main frame, foundations, and the longitudinal space required, also entails the maintenance of a second piston head, two valves, a packing gland, pipe connections, and unless the escaping gas is offensive or dangerous, its value can hardly pay for these additions and their care.

Then again, if the pump is horizontal, the piston rod *B* could be supplied with two packing boxes having a water chamber between, that would seal the outer one against the escape of gas, which would collect on top of the water and could be conducted back to the induction pipe of the main pump, even under pressure.

We are not finding fault with the invention, but suggesting methods of analysis in such cases, and pointing out that ingenuity, which is strongly marked here, may have but little commercial value.

PHOTOGRAPHIC TOPOGRAPHY.*

By Ernest McCullough, C. E., Mem. Tech. Soc.

The object of this paper is to present a method of surveying which will be a valuable auxiliary to plane-table and stadia work, and in some cases is extremely useful alone. It is by no means new, but is not very well known, and its advantages are so great that engineers who have much topographic surveying to do should understand it.

The principle depends upon the art of projecting perspective views upon a horizontal plane, and was first used by French naval officers in the beginning of this century in the survey of coast lines. Perspective drawings were made of certain places from two or more positions, and sextant angles taken to several objects in the landscape, and the angles recorded on the drawings. These drawings

*Read before the Technical Society of the Pacific Coast, May 5, 1893. Reprinted by permission.

were afterwards used in the mapping of the shore line, and the accuracy of the work depended upon the skill with which the sketches were made.

The invention of photography made it possible to do better work, and Colonel Laussedat of the French army made experiments covering a period of years to perfect the system. He published a work on the subject in 1865, and no improvements have been made since, unless multitudinous patents for cameras can be styled improvements.

The system is extensively used in Europe, and is very little known in this country, where, of all places, one would think it most valuable from an economical standpoint.

Instances can be given of the time in which various surveys have been made by this method, but such records are of no use unless the ground were known, but the French engineers generally consider that a topographical survey and map, when a camera with horizontal and vertical circles is used, can be made in one third the time required by other methods.

Any camera may be used provided it is perfectly level when the view is taken, and the smallest size adapted for the work is one with a 5×8-inch plate. Smaller cameras may be used in the same manner as a sketching pad, to carry away unimportant details, but are of little practical use unless most excellently made. All lenses must be good. Although an ordinary camera may be used, still it is better to have one for the purpose, provided with two levels on top at right angles, and four leveling screws beneath. The box should be solid, and focusing done by means of the objective slide. If the camera has a compass, or a horizontal limb, and a vertical limb, so that up or down sights may be taken, it will be complete.

Glass negatives are the most accurate to use, but paper negatives on account of portability are more convenient. The weight of the glass in the field is a drawback.

There are several adjustments of the camera which must not be neglected. The first is called "the test for register." The film on the sensitive plate must exactly replace the surface of the ground glass. To do this set the instrument up and focus for a distant view. Make a scratch to show the relative positions of the plate and tube. Take out the ground glass, and put in one with a transparent film. Focus on this, and make another mark. In actual work this difference must be allowed for by changing the focus after the removal of the ground glass, so the film on the plate will be in

the right position. The instrument maker should see to the register, but it is as well to test his work.

As everything depends upon the focal distance this must be accurately determined. Lens makers usually state the focal distance, but as it is liable to vary, the operator had better determine it himself. For simple convex lens, double or plano convex lens, measure from optic center to surface of ground glass. For double compound lenses proceed as follows: (Fig. 1.)

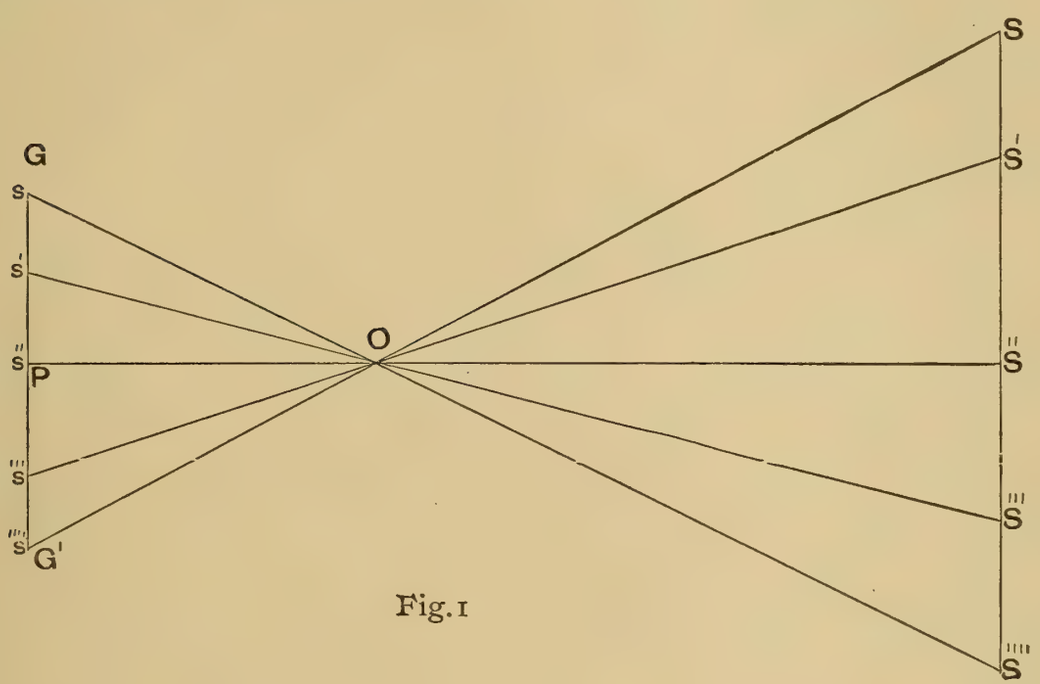


Fig. 1

Set up several stakes in the ground distant from O about two or three hundred feet as $S\ S'\ S''\ S'''\ S''''$. With transit at O, measure angles $S\ O\ S''$, etc. Set up the camera at O, level it carefully, make the image S'' coincide with a vertical line through the center of the plate, and photograph the stakes. The greater the distance apart on the plate of the stakes the more accurate will be the determination of the focal length. $G\ G'$ represents the plate, $O\ P$ the focal length. Measure $s''\ s''''$ on plate, then

$$O\ P = \frac{s''\ s''''}{\text{tan. a}} = s''\ s''''\ \text{cot. a}$$

$$S\ O\ S'' = \text{a}$$

For a test of distortion of the lens, with $O\ P$ just found, compute the angles $S\ O\ S'\ S\ O\ S''$, etc., and if they agree with angles taken with the transit the lens is free from distortion.

Next, the horizon of the view must be found. Find the center of the ground glass and draw a vertical and horizontal line through it.

Level the instrument carefully, and set beside it an engineer's level, with the telescope at same height as the lens of the camera. With the level find some object in the distance. Turn the camera to this object and move the object slide up and down until the object is exactly at the intersection of the lines on the ground glass, the object slide is then in its normal position, and a scratch on the slide will determine that position for all time. This scratch should be marked zero, and graduations should extend above and below it. The lower graduations should have a minus sign before their numbers. The plate holder should have four fine needles, so inserted in the frame that their shadows will be photographed. When the picture is developed, lines scratched on the plate and connecting these points will occupy the same positions as the lines drawn on the ground glass. The maker can fix these needles in place.

The horizontal line represents the horizon of the picture, and is the trace of a line on a level with the center of the instrument. The object of graduating the vertical movement of the object slide is to provide for a changing of the horizon when necessary to limit sky views. By noting the number on this index when the view is taken, the actual horizon of the picture is set off from the horizon of the instrument when plotting.

One more adjustment and we are done. This is to measure the field of view. Half the length of the plate, divided by the focal length gives the tangent of half the horizontal angle. The horizontal angle is the field of view we require, and dividing 360° by this angle, gives us the number of views needed to go around the circle.

Half the width of the plate, divided by the focal length, gives us the tangent of half the vertical angle. As a general proposition it may be stated that the greater the focal length, the smaller the field of view and the greater the accuracy in the work. The smaller the focal length, the greater the field of view, greater rapidity (because fewer views) and less accuracy.

To take a view, set up the camera and level it carefully. Adjust to focal length and set the object slide to the most favorable position and note index number for fixing horizon in views. Then adjust the stop, set in the plate holder and verify the levelling. The levels are apt to get a little out during all the handling. When all is ready, take the picture.

In the test for distortion, the whole idea of the method for using the proof is given. The proofs are conical projections, and the

optic center the point of view. The objects represented are so far distant that their images are formed on the same focal plane, and the point of sight remains constant as in perspective drawing.

On the plate draw the horizontal line (the horizon) and the vertical line, from the shadows of the points of the needles. If the objective was above or below the horizon, then instead of drawing it, draw a line parallel to it above or below, as indicated by the index number observed. From the vertical line measure to the right or left to the object you wish to locate, and divide this distance by the focal length, this will give the tangent of the horizontal angle from the line of sight. From the horizontal line, which is a trace of the plane of the optic center, measure up or down, as the case may be, to the object, and divide this distance by the focal length to obtain the tangent of the vertical angle.

Every point located on the map must show in two views at least. These views are taken from points previously fixed by triangulation or by direct measurement. The points from which the views are taken, must be plotted, and from these points lines drawn on the bearings given in the field notes when the view was taken. On these bearings lay off the focal distance. and at the end of this line draw one at right angles to represent the plate. On the line representing the plate, lay off on either side the distances from the vertical to the object, and from the point of view draw lines through these points. The lines through two plates produced to an intersection, locate the objects.

Figure 2 illustrates well the method of plotting. *O O'* represent the points from which the views were taken. *G G'* and *G'' G'''* the plates, *O P* and *O' P'* the line of direction of sight. *A B C* etc. and *A' B' C'* etc. represent on the plate the objects to be located and their positions on the maps are shown by the points of intersection.

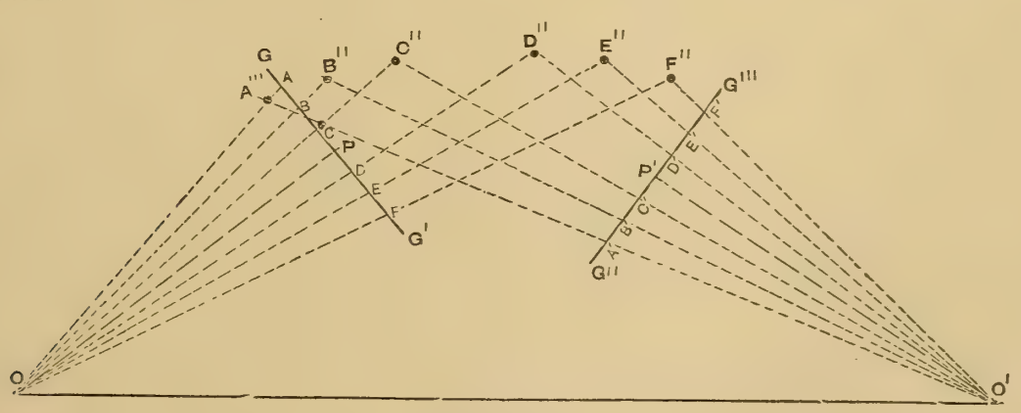


Fig. 2

To fix the elevation, measure the distance from point of sight to object, and multiply into tangent of vertical angle already found; add to the elevation of the point from which the sight was taken, the height of instrument, and add or subtract, according to whether the point is above or below the horizon, the height above ascertained. This will give the elevation of the object above datum.

Spherical aberration does not interfere with the accuracy of the work, provided the focal length is ascertained by means of a point near the extremity of the plate in the horizon. (See Fig. 1.)

The field work may be performed in one of three ways, or a combination of all.

1. The ground may be triangulated with the transit and views taken from the triangulation points with the camera, the direction of the views to be ascertained by azimuths from the lines between stations. These azimuths to be taken by a compass, or by means of a horizontal limb.

2. The camera may be used in connection with a pocket compass, the work starting from a measured base.

3. The work may be done with a camera alone, fitted with a compass, horizontal limb, and vertical circle. In this case the triangulation is carried on with the work. With ordinary care, either method is good. The camera must be rigid and the plate truly vertical.

Below is a form of record.

Station.	View.			Remainder.
	Number.	Index Number.	Bearing.	
A.....	1	0	195½°	
	2	0	227°	
B.....	1	— 2	84°	

The index number may be the same or different for all views at the same station. Any time of the year is good for this work, and any hour of the day when the air is clear. Long distances between stations should be chosen as short bases increase error. A few views only are necessary, as sketches may be made of unimportant places, and these views should be well chosen. A little care exercised in selecting positions will save much office work.

Upon the scale used depends the accuracy of the plotting. If the scale is large then very long sights should not be attempted, but if the scale is small then of course the range can be longer. The error in height is in proportion to the distance, and Professor Hardy says that with a focal length of 1.64 feet this error will not exceed one foot in 550 yards. Colonel Laussedat has shown that with a scale of $\frac{1}{3000}$ with a focal length of 0.5 m. points, 1,500 meters distant, may be represented, and with a scale of $\frac{1}{8000}$ the operations could be conducted at 4,000 meters.

When the plates are prepared for plotting the office notes are placed in a book in seven columns as follows :

FORM OF RECORD TO REDUCE HT. TO COMMON DATUM.

View.	Distance.	Point.	Ref. ft.	Ref. of Sta. ft.	True Elev. ft.	Remarks.
Va.		1	+102	+460	+562	
		2	+ 90		550	
		3	— 25		435	

The first column is for the views.

The second column contains the distances to the points.

The third column the names or numbers of the points.

The fourth column the height above or below station.

The fifth column elevation of station.

The sixth column elevation of point.

The seventh columns for remarks.

For drawing in contours, the fixing of natural and artificial objects on the plan, with their heights noted, will give all the data necessary together with a close inspection of the proofs as the work proceeds. In the case of a bare country, with no buildings, fences or trees, a few painted stakes or flags put in at salient points will serve.

It is best to work directly from the negatives as the paper positives are too much affected by atmospheric changes. Blue prints are as easy to work from as silver prints if positives are used.

Surveying by camera has equal advantages with surveying by plane-table as it is a graphic process, but it is more exact than the plane table as atmospheric changes have no effect on the records. It is more rapid in the field work, and is accurate for more than one scale in the plotted work.

As compared with transit and stadia it is more rapid in the field, and a little quicker in the office. Like it, the records may be kept,

and reproduced at any time to different scales, and it has a further advantage in that all errors of observation are entirely eliminated. Various plans for saving labor in the office work have been suggested, but this paper is already long enough.

Before closing, attention should be called to one point, namely, that the notes may be sent to a draughtsman who never was on the work, and a correct map may be drawn by him. No other method approaches it in this particular.

The literature on this subject in French and German is very extensive, and the following works in English are very good if any one desires to study the subject farther.

Photography Applied to Surveying, by Lieut. Henry T. Reed, U. S. A.

The Topographer, His Methods and Instruments, by Professor Haupt (latest edition).

Topographical Surveying, in No. 72, Van Nostrand's Science Series.

ENGINEERING CONGRESS AT THE WORLD'S FAIR.

The Engineering Congress, to meet at Chicago on the first of August, will be the most important conference of the kind that ever assembled in this country, or in any country, because the delegates will represent the principal countries of Europe as well as on this continent. The divisions will include civil, mechanical, mining, military and marine engineers, with in some cases branches of these.

The following extracts are taken from a circular issued by the general committee, and give all required information :

"There will be an opening general session at 10 o'clock on Monday, July 31st, 1893, in one of the large halls of the Art Palace, now building in the Lake Front Park in Chicago. This is the business, or down-town, part of the city, and not at the Exposition grounds. After appropriate addresses the divisions will be convened in their respective session rooms in the same building.

Cards of admission to the Engineering Congress will be issued by the Secretary of the General Committee upon the presentation of introductory cards given by the officers in charge of the several divisions, or by the officers of the societies invited to participate in the congress.

The cards of admission will entitle the holder to attend the meetings of any of the sessions. There will be no entrance fee for participation in the proceedings.

The proceedings will consist of the reading and discussion of such papers as shall have been accepted by the management of each division, and according to the rules which may be adopted. It is expected that a number of these papers will be secured and printed early in 1893 so that copies can be obtained (but not for publication) by those desiring to offer contributions to the discussions.

In general the papers will not be read at length in the congress, but will be printed in advance and presented in brief abstract, so that the discussion may proceed with as little loss of time as possible. As a general rule precedence will be given to those who shall have sent in discussions in writing, and subsequently to those who shall have given notice of their desire to be heard.

Papers to be presented will, for the most part, be secured by direct invitation, but offers of papers are welcome at any time, subject, however, to acceptance by the officers in charge of the division to which such papers may belong.

Preference will be given to papers which relate to new and important constructions, machines, processes, methods, experiments and investigations. It is very desirable that papers be sent in early and this may be essential for securing their favorable consideration.

Correspondence relative to the time when proposed papers must be transmitted for acceptance should be addressed to the representative of the divisions concerned.

Opportunities will be given for the display of wall diagrams, and of stereoptican (magic lantern) views in illustration of papers.

It is intended that all papers printed by the divisions shall be in English. Papers may be offered in French, Spanish, German and other languages, and if accepted will be translated and printed in English. Discussions may be in any one of the three languages mentioned, and interpreters will be provided whenever necessary.

It is evident that contributions requiring translation should be transmitted at the earliest possible day. Information concerning scale, size of drawings, etc., should be obtained from the representatives of the divisions, who will also issue advance copies of the papers.

A daily programme will be issued each morning by the General Committee stating the order of papers and proceedings, so that engineers in attendance may select the sessions at which they prefer to be present. This programme will indicate the rules to be followed, and, as far as practicable, the speakers who are to take part in the discussions.

There will be five morning sessions of the divisions, some of which may be joint sessions.

The congress will terminate with a general morning session on Saturday, Aug 5, 1893, on which day there will be no divisional sessions.

The afternoons may be devoted to further sittings, or to visits to the exposition. or other points of engineering interest, as may be determined by the divisions.

It is expected that the evenings will be given up to receptions and social intercourse.

It is contemplated to publish the entire proceedings of the Engineering Congress, and to sell copies at cost to engineers who may subscribe for the same, but the societies having in charge the management of divisions will have the right of publishing appropriate portions of the proceedings of their divisions. All contributions accepted will be subject to the usual control of these societies over their own publications, including the editing of manuscripts, the determination of typographical style, and the number, scale, and kind of engravings, the concurrence of the author being secured on all essential points, and proofs being submitted to him when time permits. This will not interfere with any publication for which the Auxiliary may arrange.

ADVERTISING BY TECHNICAL PAPERS.

One of the European journals of high standing, comes this month with a criticism respecting a paper read before the late meeting of the American Institute of Electrical Engineers on "Micanite," which it is claimed, is merely a trade advertisement. The criticism includes similar proceedings in other countries and in other societies, and invites the question of how to avoid the misuse of technical associations in such cases.

The line of distinction is easy to set up, in so far as the nature and objects of such papers, but to form general rules to exclude advertising papers is not so easy a matter.

Members engaged in certain technical branches of industry are of course to be excused for presenting that which they best understand, and the benefit that may be derived from papers of the kind is not lessened by the fact that the author is commercially concerned in the matter presented, but there are proper bounds which common discernment will point out, where instruction ends and advertising begins.

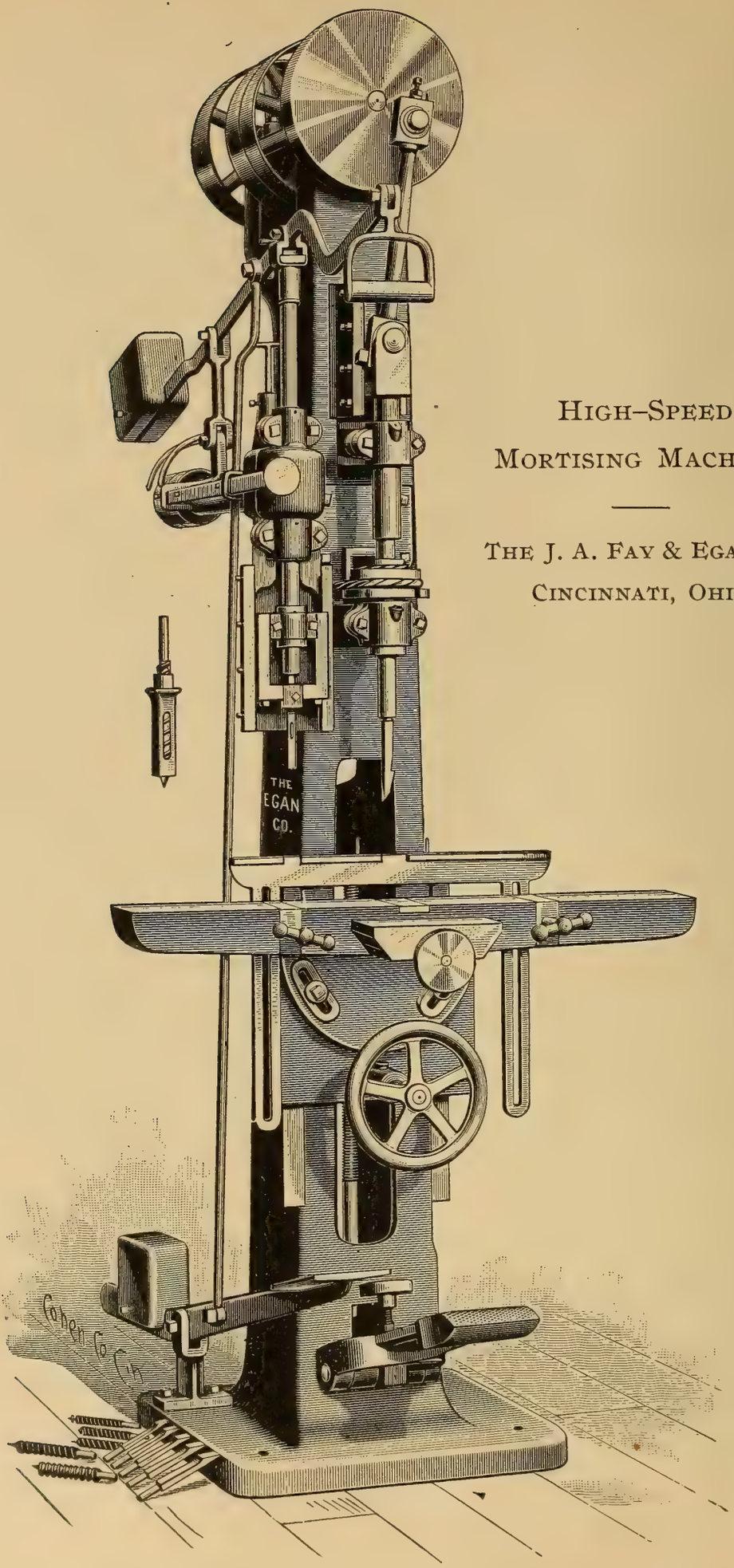
There is no denying that the incentives to produce technical papers are in most cases personal advantage. All human actions have such an object, but as before said, there is a limit fixed by good breeding and education which must be observed. In one of the principal technical societies in England there is a wholesome regulation respecting papers, demanding that they must be written in the third person, or the impersonal pronoun. This is a first and main step toward shutting out the advertiser. He deals in "we," "us," and

"our," and is nonplussed if he finds the pronoun stricken out of his manuscript. There is a rule, simple and obvious, governing this matter, not only in technical papers, but in all cases. It is this: Whatever is addressed to more than one person, or to persons not known should be written in the third person or impersonal pronoun. Whatever is private, addressed to one person, can be written in the first person, and may be addressed to the second person if an acquaintance. Public papers and all advertising matter of whatever kind comes in the class first named, and well educated people so frame such matter. By education is not meant so much scholastic qualification as an acquaintance with the customs and the conventional rules of literature.

To those not accustomed to writing, it seems a most difficult matter to write in the impersonal pronoun, but it is not so. It is only a matter of some study and education in the art, and it is in this way that our technical societies may to a great extent avoid advertising matter from getting on their records. The society before referred to, the Institution of Civil Engineers in England, has always had such a rule in respect to papers contributed to that association, and no complaint is ever made of it. It is natural, easy and proper, to the extent there demanded.

In some cases the pronoun is unavoidable, but it can always be in the third person, as the "author," or "writer," and need never be "I," "me," or "us." The audience and the public to whom technical papers and technical matters of all kinds are supposed to be addressed, are not concerned in the person, but the subject, unless it be in the case of someone highly distinguished. In fact, speaking or writing in the first person implies such distinction. Alexander von Humboldt in science, Mr. Carlyle in essays, or Virchow in medicine, may write in the first person, after the manner of kings and great people, but the same thing would become ludicrous in the case of people less eminent.

This subject is dwelt upon because it seems the first step and an easy one to take in preventing the presentation of technical papers in an advertising form, or in a form offensively so. It is, moreover, a rule which would be of more benefit to those presenting papers than to anyone else, because adding to the dignity and dress of the matter, and spreading a kind of information that most people will be very thankful for.



HIGH-SPEED
MORTISING MACHINE.

THE J. A. FAY & EGAN CO.
CINCINNATI, OHIO.

HIGH-SPEED MORTISING MACHINE.

THE J. A. FAY & EGAN COMPANY, CINCINNATI, OHIO.

The mortising machine shown in the drawing on the opposite page, is a recent design for a machine which may be claimed as a purely American one. The terrific speed at which they can be, and are driven in most cases, is not a congenial feature in the older countries, besides the method of operation is one not much known outside of our own factories.

In 1870 the highest speed with European machines was about 150 revolutions per minute, while American machines were driven at 500 revolutions per minute, and had an efficiency greater even than the difference in speed. Since that time have followed various improvements, ending up with a hollow chisel attachment shown on the left of the present machine, that will no doubt be very useful in many cases, especially for hard wood, and when rectangular mortises are required for sash mullions and the like.

The main features of the machine are, that the feed movement is performed by the table, the material being raised to the chisel, and the reversal or intermittent rotation of the chisel is performed by the friction of a slipping band.

The effect of table feeding, is to alter the whole nature of a mortising machine, and eliminating the complications that necessarily belong to all machines that feed the chisel down to the wood. The crank shaft becomes fixed, the reciprocating parts a plain slide and chisel bar, and there is no limit of speed, except in the presentation of the wood. The slipping belt not only revolves the chisel and chisel-bar instantly and independent of the reciprocating motion, but holds it firmly when reversed.

Take it all in all, the production of this type of mortising machine was one of the greatest advances toward simplicity and efficiency that can be referred to in the history of any wood-working machine.

The hollow chisel attachment in the present machine seems to call for no addition to the mechanism, except a small slide seen at the lower end of the boring spindle on the left, and no change from boring to mortising, except to insert the hollow punch shown detached at the side of the machine.

There are various refinements in the machine as here produced by the J. A. Fay & Egan Company, and the design is one of the latest and best.

35-TON REFRIGERATING MACHINE.

VULCAN IRON WORKS, SAN FRANCISCO.

[See Frontispiece.]

The frontispiece in the present number, shows a refrigerating machine constructed by the Vulcan Iron Works, in this City, that is an example of good practice, and warrants the assumption that in this line of engineering work the establishments on this Coast can maintain a successful competition with makers anywhere.

We examined this machinery before it was sent to the Gambrinus Brewing Co., of Portland, Oregon, for whom it was constructed, and were a good deal astonished at the care with which many of the details were worked out, especially the clearances in the ammonia cylinder or pump, which have been, by careful fitting, reduced almost to nothing at all. The proportions throughout for all parts are heavy, corresponding to the high pressure dealt with, and as seen in the drawings.

The steam engine is of the Corliss type, in so far as valves and method of regulation, but is of increased strength over the common engines of like diameter and stroke. The ammonia cylinder is surrounded by a jacket for circulated water, to avoid heat, and the piston rod glands are also arranged to be cooled. The valves set diagonally so as to shut close to a chamfered piston head and avoid clearance there.

The Vulcan Iron Works have been eminently successful in this line of practice, and are now engaged in making two other plants of similar design to that shown, for firms in this State, and have executed successfully a number of foreign orders for ice-making and other refrigerating machinery.

It has taken a good many years for people to find out the many uses and importance of low temperature in preserving food, and in various industrial processes, also a good many years to perfect the machinery required, but there is now no impediment or risk in adopting such plants. The Vulcan Iron Works recently furnished apparatus of the kind for freezing salmon in Alaska, preparatory to shipment of the fish to the Eastern markets.

EVAPORATIVE SURFACE CONDENSERS.

Mr. M. Longridge, a well-known civil engineer in London, has been making some experiments with evaporative condensers that should command attention here, where condensation is more important than in any other American city of the size, and the expedients now adopted are both extensive and expensive. At the Union and Risdon Iron Works, also at several of the largest cable railway power houses, cooling troughs have been erected on the roofs, and are maintained with a good deal of annoyance and expense. In other cases long lines of pipe have been laid to the bay and salt water drawn in. Such pipes are subject to being clogged by mussels, or other marine growths, so that on the whole the gain of a vacuum is at a cost very nearly equal to the saving in fuel effected.

Evaporative condensers are those wherein the steam passes through, or into pipes exposed to the air, with water trickling over their outer surface, and correspond, except in their object, to apparatus employed for evaporating cane juice in Louisiana twenty-five years ago, and possibly at this time. This consisted in tiers of copper pipes, through which the hot steam was conducted, and over the surface of which the cane juice trickled in such quantity that it was evaporated down to thick syrup at the farthest point from the supply, or at the lowest point.

In Mr. Longridge's experiments the condenser was formed of two rows of vertical iron pipes 4½ inches diameter, joined by arches at the top, the water being supplied at the highest point, and permitted to flow down over the vertical pipes, which are set in two main trunks of larger bore, the construction being nearly identical with a common radiator.

The sugar-mill evaporators, before referred to, were much more perfect, consisting of thin copper pipes of 4 inches diameter, set horizontally in tiers about seven feet high, each tier having eighteen to twenty pipes, the ends joined by "return" fittings at one side, the other ends connecting to a vertical supply pipe. The cane juice was fed on the top pipe, and descended from one to another in a thin sheet until it ran off as a syrup at the bottom. We mention this matter to show that the method is not new in so far as its general features. Of course the object was different in the two cases, one was to boil or evaporate syrup, and the other to condense the steam in the pipes, but the method is quite the same.

Before noticing the results of Mr. Longridge's experiments we will quote the following interesting remarks from an article of his in *Industries*, London, No. 353 :

"Roughly speaking we may say that with an evaporative condenser one pound of water evaporated on the outside of the condenser is sufficient to absorb the heat given up by one pound of steam condensed inside, or that the weight of cooling water is only equal to the feed. In practice it is even less, for certainly some heat is lost by radiation and conduction. As in the case of the ordinary surface condenser, the condensed steam is pumped back into the boiler.

If this explanation be correct it becomes evident that when such a condenser can be put up no engine need work non-condensing for want of sufficient cooling water. For the feed-water required for a non-condensing engine being more than sufficient for a condensing engine developing the same power would *a fortiori* be more than sufficient to condense the steam from the condensing engine if used on an evaporative condenser, while the fact of the condensed steam being returned to the boiler would render the provision of fresh feed-water unnecessary, except so much as might be required to make up the usual small leakages and losses from safety valves, drain taps and glands. It was to illustrate this proposition that the observations about to be described were made."

The experiments referred to were made in Dundee, Scotland, in the works of an engineering firm there, who made the condenser, and employed it in their own works. The following particulars are taken from Mr. Longridge's table, and include only one set of observations taken on a dry day :

Temperature of Air, Degrees Fahrenheit	60
External Surface of Condenser, Square Feet	272
Duration of Trial, Minutes	115
Weight of Steam Condensed, Pounds	800
Weight of Water in Circulation, Pounds (about)	1,830
Weight of Fresh Water Added, Pounds	640
Vacuum in Condenser per Gauge, Inches	24.1
Initial Temperature of Circulating Water, Degrees Fahrenheit	113.9
Final Temperature of Circulating Water, Degrees Fahrenheit	125
Temperature of Supplementary Fresh Water, Deg. Fahrenheit	58
Weight of Steam Condensed per Minute, Pounds	6.95
Weight of Circulating Water Delivered per Minute, Pounds	113.1

We need hardly say that this is most remarkable. The weight of circulating water delivered per minute is not set down in the experiment quoted above, which was made on a fine day, but is given in a previous experiment made on a wet day, and we have substituted the figures in the column above, for a dry day, so the amount is perhaps too small.

Assuming, as Mr. Longridge claims, that a given weight of cooling water will condense an equal weight of steam, or, in other words, that the cooling water required is no more than the feed water, there is no reason why nearly all the steam engines in use should not be made condensing. There is, indeed, no loss of water at all to be considered, because there is no waste except by evaporation from the pipes, and the cooling water amounts to no more than the feed-water for a non-condensing engine.

In common condensing apparatus where the water is circulated and cooled, the volume of water passing through the condenser is at least twenty-five times as much as the feed-water, or 25 pounds of water is required to condense one pound of steam. The cooling apparatus, whatever it may be, is on the same scale. On this point Mr. Longridge says:

"In the case of the ordinary surface condenser the work is done in a closed vessel, and the heat given up by the steam is employed exclusively in raising the temperature of the cooling water. The cooling or heat-transmitting surface is comparatively small, varying from about one square foot per indicated horse power in ocean-going steamships to 2½ square feet for land engines in the tropics, but the quantity of cooling water required is large, for each pound of water can only absorb one thermal unit in rising one degree in temperature. Thus if the cooling water be heated from 60° to 110° each pound will only take up 50 thermal units, and the number of pounds required to absorb the 1,000 units liberated by the condensation of one pound of steam will be $1{,}000 \div 50 = 20$, or the weight of cooling water required will be about twenty times the weight of the feed."

The thermal analysis, which involves a second table, we will not enter upon further than is above given.

In respect to the condenser used in these experiments we will venture the opinion that it was by no means as effective as might have been. The metal was $\frac{5}{16}$ inches thick, and the main faces vertical. If the metal is ⅛ inches thick, and the surfaces set at an inclination low enough to cause a slow flow of the cooling water, the effect would certainly be better, and if copper instead of iron, the effect would be much increased.

In this climate we have the advantage of a cool atmosphere in shaded situations exposed to the wind, for nearly the whole of the year, including the warmest days in summer, and there is no doubt that properly constructed evaporative condensers can be employed here with much saving in the amount of fuel consumed for steam power.

THE HYDRAULIC MINING PROBLEM.

There is in California, a peculiar industrial interest, born in late years, unique in nature, and one that can not well be carried on without trespassing on the property and rights of others — that of hydraulic mining.

This term is applied to the use of spouting water delivered from nozzles under high pressure as a means of eroding and disintegrating the earth, especially clay formations, which are torn away in thousands of tons, and washed by the same water into streams to be carried down to lower levels and into navigable streams, building up the bottom and banks, raising the level until the cultivated alluvial lands are flooded, or covered and destroyed. This operation has been formerly carried on to an extent that surpasses any inference that can be derived from description and without seeing the giant nozzles at work. It is terrific, and the results are amazing.

The evil done is two fold, the destruction of lands that belong to private owners, and the obstruction of streams that serve public purposes, also by the deposition of silt in the bays at San Francisco, producing physical changes of great extent, so the general government, as well as the farmers, became complainants against this aggressive industry.

The government authorities have by exhaustive observations, determined the "fact" of damages to navigation, and the alteration of streams. The injury to farm lands is obvious, without scientific investigation. We have seen on the Feather River the tips of the trees of an orchard sticking a few feet out of a waste of sand, and vegetation blotted out, because there is not in this coarser "debris," as it is called, any element of fertility, and lands once covered are lost, for ages at least.

The finer silt, called "slickens" remains in suspension and is carried down to the bay, or bays around San Francisco, into which the two great rivers, the San Joaquin and Sacramento, discharge their waters.

These bays make up 500 miles of coast line, but there is enough slickens to coat the shores with a layer of this fine silt wherever the currents are not strong enough to wear it away. The tide flows up into creeks, estuaries and bights of the bays, and when the water comes to rest, the "slickens" settles down, building up everywhere until vast areas are shallowed, and become mud sloughs or morasses.

It is true this process has always been going on by natural erosion and independent of hydraulic mining, but only at a slow rate, and the deposit was different. The natural silt, it may be called, was mainly soil or debris that when freshened and the salt washed out, was fertile land, but the compound from the mines is of a different character, and the process of deposition has gone on at such a rate, that people now living and not old, have seen a total change in the hydrography of the rivers, and very near a destruction of navigation in the Sacramento and some tributary streams, also have seen large areas of the most fertile land, either covered with sand or drowned with water by change in the level of streams or obstruction to their flow.

It is not the purpose to deal here with the technical conditions of this matter, hence "quantities" will not be included, but instead some comments made on the economic and legal aspect of the problems. The organic laws relating to damages in so far as injury to personal property were quite sufficient to deal with the case, but as navigation was also involved, the paternal functions of this Government were invoked, resulting in decisions by the Federal Courts inhibiting the pursuit of hydraulic mining in certain cases, or in all cases where the debris was carried into navigable streams. This departure from the code or common law, of course called for special acts, and a new law was enacted by the last congress defining certain conditions under which hydraulic mining could be carried on. This law provides for a commission of three members to be selected from the U. S. Army, Engineer Corps, who shall furnish or approve plans for restraining works to impound the debris from the mines. The law also provides for a fund to be derived from the mines discharging into the restraining works, the amount so levied to be three per cent. of the product and to be assessed *pro rata* by the commission.

The added powers are little more than the Engineer Corps already exercise, or can exercise, but an appropriation of fifteen thousand dollars is made, to defray extra expenses, a sum that will not go far in that direction.

The act is redolent of "injuries to navigation," but says very little of damages to personal property and private interests. It moreover, in some of its wording, implies that the government is to construct impounding dams, and a proposed act of the Legislature in California is to vote the sum of 250,000 dollars for constructing such works, "on condition that the Federal Government provide a similar amount."

The economic conditions, in so far as affecting the State, are not easy to determine. The industry of hydraulic mining, is extensive, and if, like others, it could be carried on upon the premises of the owners without subvention, everyone would be glad to see it developed in the fullest manner, but in the heated controversy that has arisen, it is very difficult to determine what the true importance and value of the industry is or may be.

It is commonly spoken of by its friends as a "loss or gain to the State of the whole product," ignoring the fact that such loss or gain to the State can only be derived from the "profits" of the hydraulic mining, and in this way a gain only by taxes collected from mining property, added employment, and the profits of a more etxended commerce.

Four fifths, if not nine tenths of the profits will naturally go to the mine owners, where it belongs, and when a balance is struck between the actual gains and losses to the public, the difference becomes the true matter at issue.

To strike another balance between the net profits of hydraulic mining and the damages to personal property, furnishes another economic problem, but not a public one. It is a case between certain citizens who own the mines, and other citizens who own property along the rivers, also a still larger number of people who are interested in conveying their goods and products on the streams.

As a whole, the problem, if it is to be carried outside the common law, calls for a decision by some high tribunal that is competent to deal with the intricacies and equities involved. Special legislation is not likely to accomplish much. It has taken centuries to determine the laws of damage and compensation. Attempts to frame new laws for special cases have generally been failures. It is equivalent to setting up a government within a government, and is an infraction of those principles of equity which are supposed to lie at the bottom of our political system.

The only fair way to deal with hydraulic mines, is to put them on the same basis as other industries stand, permitting the owners to do whatever they like within the boundaries of their own land, and make them responsible for whatever damage is caused to others outside these boundaries. No further right than this is accorded to other citizens or their business, and there is a close guard over all infractions of this rule. Even smoke, which is an unavoidable accompaniment of many industries, is in many places, and soon may in all places, be legally declared a nuisance, and an infraction of personal rights.

No doubt the true animus of the matter on the part of the owners of hydraulic mines, is to secure appropriations of public money, State or Federal, or both, to construct impounding works. The only other object that can be conceived of, is to remove existing injunctions against hydraulic mining, that may be unjust or uncalled for. There is nothing to hinder the construction of such impounding dams by the mine owners, and no enabling act of congress was required for that purpose, and it remains now to see what the next movement will be under the newly appointed commission, of which Col. Geo. H. Mendell is the chief, and who is not likely to encourage or permit any use of public funds not warranted by public interests.

TIN PLATE.

That extraordinary tariff legislation known as the McKinley Act, raised the duty on tinplates to $2\frac{1}{5}$ cents a pound. This law was approved in October 1890, but the increased duty on tinplate was not to go into effect until July 1st, 1891, nine months later. The ostensible reason for this delay in the operation of the new tariff, was that by that time nearly the whole amount consumed would be made in this country, but there is reason to believe that the main object of the promoters of this measure was to reap the profits of a large importation of tin plates during this time, that would be enhanced in value by the higher tariff.

When the nine months came around no tin plate had been made, not a box even, in the sense of it being an established commercial manufacture, but tin plate works were exploited so fast that the reports of them were usually telegraphed to Washington and the amount of deception and untruths published are simply amazing.

The American Tin Plate Manufacturers Association, mainly an association of sheet iron and steel manufacturers, on January 10th, 1892, issued a statement that the "capacity" of the factories was 30,545,300 pounds per month, or over 180,000 tons a year. About the same time the Tin Plate Consumer's Association, reported that no coke tin plate at all had been put on the market, and that the losses to the American consumers had been more than $10,000,000, by reason of the higher duty, and that on the cost of their material the loss was $15,000,000.

These reports were so contradictory and caused so much comment, that a tin plate commission was appointed to investigate the

matter, and to make sure of some kind of showing, it was decided that imported black plates, dipped in imported tin, could be reported as "American tin plate."

This constitutes the present tin plate industry in this country. In 1892, the imports of black plates from Wales, was only 1,750 tons less than the whole of the tinned plates produced here, showing that not even the "stock" was being made. The mines opened under the stimulus of the McKinley Act have caused immense losses, and the whole scheme, it may be claimed, has been a failure. This attempt to establish manufactures by law, irrespective of natural resources, and by a tax on other industries, is a lesson that should be remembered in this country. No one doubts that we can make tin plates or what will answer in their place if need be, but until there is such need there is nothing to warrant thrusting a dirty and unhealthy "branch" of this manufacture upon the American people at a cost of ten millions of dollars a year.

No permanent or useful industry was ever built up and maintained by such unjust means, and the people are now beginning to inquire who it was that had most in view the benefits of the country, the tin plate promoters, or those who have protested against the enormous tax placed on an article that is almost wholly consumed by the poor and in industrial purposes such as the poor are mainly concerned in.

If the purpose was only to promote the manufacture in this country, the fairest way would have been to take from the national funds and pay over to those who produce tin plate a subsidy on their product. This would have been a much cheaper plan, and would have avoided the speculation and deceit that has characterized this matter for three years past.

In 1891, by connivance of a friend, we procured a copy of a prospectus issued in London, respecting the Temescal tin mines in this State, we were not at liberty to show it to any one, but made notes respecting some of the main points which were presented to some of our ablest mining engineers here. The statements and estimates were laughed at. All agreed that if tin ore existed there in paying quantities, there was no lack of capital and skill in this country to work the mines, and the tin would long ago have been raised, smelted and sold.

We need not refer to the subject further than to say that even down to within a month of the time when the mines were closed, a large share of the public journals declared that there was an endless

amount of tin there, and the country would soon be supplied from Temescal. These things can produce no good, only infinite harm in the end.

RAILWAYS AND THE PUBLIC.

The "defense" of railways in this country is becoming a science, and will be necessary in all of its phases before long. There is a growing antagonism between the public and railways, for which neither side is to blame, or at least one side is as much to blame as the other. The capital of this country has been penned up at home without chance of investment, until many manufacturing interests have been swelled far beyond the requirements of the day, and hence have become unprofitable in a large share of cases.

Ocean commerce could not be carried on under inflated prices. Wages, taxes and dues of one kind or another have prevented competition with other nations. Enterprises in other parts of the world could not be equipped from here because of the enhanced cost of material, implements, appliances, and the interest on money. All of these have prices for use and consumption within the zone of protection, but impossible elsewhere; hence our people have been confined to home investments. Railways presented almost the only opportunity, and these, like all other interests confined to domestic operation, fall into home competition until their earnings are depressed below fair compensation. Then followed a struggle for means of forcing revenue by combinations, pools, strategy and legislation, advantages that have caused the distrust and prejudice that pervades public opinion respecting railways.

All disturbance of the natural causes that determine prices must result in something of the kind. The inevitable laws of economics move on like the waters of a stream, it may be dammed for a time, but the cumulative waters must find their course. A policy that confines the operations of a vigorous people, with great resources of production, within their own boundaries may seem for a time to produce prosperity, but the penalty will come, if not in one form then in another.

The over-building of railways in this country is a serious matter. To say that vast areas have been opened up, and brought within the reach of markets is to repeat an obvious truth, but who is benefited? Who can prove that we are better off by having sixty millions of population in 1893 than if we had but forty millions? and is the

sudden opening of our western lands any better than pushing forward gradually the fringe of population, reserving the lands for settlers, avoiding the speculator and the enormous grants to railway companies. There is a craze to grow, expand and develop. It is the supreme object of American ambition, but is not philosophical or a road to happiness for the greatest number.

COMMUNICATION.

To the Editor of Industry:

Sir:—I cannot refrain from criticising your comment on Senator Stewart's conclusions that silver costs its producer on an average $1.50 to $2.00 per ounce. Your criticism is "that its cost is less than what it sells for, otherwise it would not be produced." I admit the truth of this axiom when used in a reasonable way, but it certainly is not applicable to mining of gold and silver. To illustrate, three business men of San Francisco, noted for their good sense and business ability, bought a gold mine, result, each spent $1,000 for each $1.00 received. Again we will say that a man buys a developed mine, measures the ore and makes sure of what he has bought—say a silver lead mine—when he begins operating, a lead trust and a railroad-freight combination are formed, a smelting pool is added, to these add strikes and lawsuits if you like, and a falling market for silver, and under such circumstances the result is he loses money, and the silver produced costs much more than it is sold for. You may say that he should have foreseen all these contingencies, and provided against them, but if such advice was followed all business would cease on account of the risk. From personal investigation I think both silver and gold cost more than their market value. As to the lost work from speculative ventures, do you know any kind of work that is not speculative in great or lesser degree? Take agriculture, does not the farmer speculate against the odds of the elements, combinations of men, insects, sickness, etc.? and this is supposed to be the safest and most honorable occupation.

Suppose we view the question in another light. The business of the world being largely on credit, and the obligations of indebtedness are concentrated in relatively few hands. Now if such debt is payable in gold or silver, and if silver can be demonetized, will not the value of gold appreciate? and seriously that is the whole case in brief. Do you know anyone outside of the creditor's class fighting silver, and if so, why does he do it, what will he gain? (Newspaper men are not included under the latter queries as their motives are never questioned.)

Sincerely yours,

Luther Wagoner.

Ruby, Washington, Apr. 14, 1893.

THE KAISER.

The Emperor of Germany has failed to load upon the nation new charges for the war establishment, and is incensed accordingly. The thrones of most kingdoms rest upon a war foundation, and the Germans are no doubt beginning to question the value of both. This pretense of maintaining a vast army for safety, is one of the wickedest sophistries of our time, and of all times since people ceased to be savages. It is the countries with great armies that get into wars. They must do so; that is what the armies are for. Germany, without a soldier, other than is required to maintain or enforce her civil laws, would be safer in Europe today, than she is now with her abnormal armament. This country has gone on for eighty years at peace with all the world on the high seas. Men have grown up from childhood to old age without knowing of either danger or cause for aggressive action at sea, but now that we are preparing a great navy it will not be long until there will be work for it to do. As to the dread of attack in Germany, why are not Denmark, Sweden, Holland, Belgium or Switzerland subjugated? Is it because they have great armies, or no armies to speak of?

The great powers can no longer wage conquest, they do not want to do so, being restrained by a spirit of humanity and justice. If these are not controlling forces, what boots our boasted civilization. The people of great nations will not permit wrongs to be inflicted on weaker powers, unless the weaker powers collect armies and invite war.

Denmark lost the Schlessing-Holstein Peninsula by her pretense of an army and attempt to cope with Germany. The subjugation of the Danish forces meant conquest of the country, which would never have been dared if there had been no army to oppose. It is the armies that give excuse for conquest. Without them, no modern nation could be brought to the position of stealing a country or oppressing its people.

Germany must unlearn the policy of exalting the army above her industry and commerce. The late war with France may leave a menace, but this was a result of armies and ordained rulers. If the Kaiser and the army also were "deported," it would, no doubt be a happiness for Germany and other nations menaced by these joint institutions.

THE NEW INTERNATIONAL STEAMERS.

The *Engineer*, London, has some uncomfortable criticisms upon the new ships being built at Philadelphia for the International Company, and says it is questionable if these new steamers will make the run between Liverpool and New York in six days, that the steam pressure of 210 pounds per inch is too high, and calls for boiler plates 1½ inches thick, with flues ¾ inches thick, and that to develop the 15,000 horse power required, there will be burned 17 tons of Pennsylvania coal an hour, and probably 2.5 pounds per horse power developed, and to burn this amount of coal, or 46 pounds per foot of grate surface, forced draught equal to one inch of water will be required.

As Professor Biles, of Glasgow, was consulted, or had some hand in designing these vessels, there is certainly some mistake in these assumptions of the *Engineer*. Professor Biles designed the *City of Paris*, and the *City of New York*, and certainly would not have recommended quadruple engines and 210 pounds of steam pressure, if it involved the conditions above pointed out. Thick flues are a bad feature, not only with loss of heat, but also as to danger of fracture or "giving down," and this imposes a limit of steam pressure; but all this was understood in designing these new vessels, and we hope to hear a more favorable representation of this matter. It is hardly to be expected that the *Engineer* would look with much favor on this first attempt in this country to build ocean steamers of the largest class, and is no doubt in error as to the premises on which the above assumptions are based. If not, some alteration would be expedient.

In respect to quadruple cylinders, there is certainly room for doubt as to the expediency of such an arrangement for vessels. The concensus of present opinion on this subject will perhaps show that even triple engines may exceed the true economic standard, if the proportions of compound or two-cylinder engines are so arranged as to attain the same expansion, and that the gain by these is in a better distribution of turning strains on the crank shaft, and a more symmetrical or narrower construction of the whole.

It will be no great wonder if 100 pounds of steam pressure and two cylinders as 6 or 7 to one, will be found in the end as economical as triple and quadruple engines, this is the view of some engineers whose opinions are entitled to weight.

Miscellaneous Notes.

Whatever else may be claimed for an increase of custom duties, no one can pretend that it has reduced imports into this country. This is, in a popular way, the principal claim made for a high tariff system, but any one who will follow the mercantile transactions in import trade will be at a loss to find at what point the high duty acts as a bar to imports. If the duties are added to the price of domestic products there will remain the same choice as before between these and imported goods. If the duties are not added to the price of domestic products, then it has no object of a protective kind. The fact is that a high tariff does not prevent importation as present circumstances prove, and as the drain of gold from this country too plainly shows. As above mentioned, one has only to ask in what practical manner a duty prevents imports to find out that it is only a vague idea.

The indefinite article "a" or "an" meaning "one," seems a superfluity in our language, but the definite article "the" has never been, until recently questioned, as a proper part of speech. Now, however, we find it used in a new sense, indicating the collective and indefinite, or exactly the opposite of its definition. In a leading magazine, recently, there was an article on "The City Hall of America," and now, in the *North American Review*, comes "The Horse in America." Accustomed as we are to loose expressions, there are very few who would not construe this literally, as meaning some particular hall, and some special horse, but it turned out to mean "City Halls and Horses in America," which the authors should have written. Even a Professor, H. H Boyesen, also in the *North American Review*, writes of "The Scandinavian in the United States," when he means Scandinavians, all of them, not a particular one as the title indicates. We hear, on all sides, the definite article applied to indefinite things, and if one sets out to hunt a reason, the only one that appears is an innate depravity of expression. It is slang, or very like it.

The new Masonic Temple Building, at Chicago, is a modern marvel. It is 302 feet high, contains 19 full stories, has 7,000 electric lights, 1,328 steam radiators for heating, 11 miles of steam pipes, 24 miles of water and gas pipes, 4,700 tons of steel beams, and 17 elevators capable of carrying 50,000 people daily. The power plant, made by Fraser & Chalmers, of Chicago, is 1,000 horse power, two engines of 500 horse power each, with eight boilers of the Scotch marine type, each weighing 17 tons. The total weight of the machinery is 325 tons. It is strange when we consider how a "power plant" has become a part of modern buildings, a necessity arising out of the prices charged by the public service, for power, light, water and heat. This is no economic reason, indeed the reverse, for maintaining in each large building a power equipment for purposes that come clearly within the scope of centralized production in large cities.

A late number of the *Railway World* gives a fine description of the railway works of the London and Northwestern Company at Crewe, between Liverpool and London. This is the locomotive plant only, or rather is the metal working department, where the engines and other machinery is made and kept in repair. The number of engines is 2,700, and the people employed 19,000. The work performed yearly is valued at $3,250,000, and the total engine mileage is 61,500,000 miles. There are 10,000 engineers and firemen. The writer remarks, respecting locomotives, that they are much cheaper than horses, being worth only "seven cents a pound when completed." At the Crewe works is made the electrical and steam-ship and other machinery for the line, which, like all English railways running to the coast, own their own boats going to Ireland, across the channels, and to the Isle of Man. The great wood-work establishment, where the carriages for the line are made, is not included in the Crewe works.

Now that the horse, or to be grammatical, "horses" have risen to the dignity of forming the subject of an essay in the *North American Review*, and being a factor in our industrial affairs, we make room in this Journal to say that, so far as we can see, horses know less than their long eared progenitors, whose name is a synonym with stupidity. A horse has a brain about the size of a dog, a smallish dog, or a fortieth part as much in proportion. His wit is in the same proportion and on a par with the feathered part of animal life. By intimate association with mankind his sagacity is greatly exaggerated. He is abused, overworked, and turned out to die without a pension, or thanks even for a servitude that no other animal would endure. He runs away, in terror, at nothing, and stops not for a stone wall that happens in his path. No other animal is so simple as this. In the stupidity of horses is their chief value. Their great strength is a wonderful factor in our economy, and is stolen, as it were, without proper gratitude or acknowledgment. There is a fearful balance in the horse's favor that will some time be settled we hope, in the awards for human cruelty, but as to equine wit or sense, it is a myth.

The exportation of matches, from Sweden, is about 16,000 tons a year, and is a well deserved trade, because the matches are far superior to those made in other countries. They appeal to our mechanical sense in being packed in boxes of uniform size, made of wood, covered with paper, and are stiff and durable. They are also "*utan svafel eller fosfor*" "without sulphur or phosphorus," which is another recommendation that needs no mention. Ships are loaded with matches at Gothenberg, so far as possible, some heavy material, commonly iron, has to be placed at the bottom for ballast. This is convenient because Gothenberg is an iron shipping port. This *Tandstik* (lighting stick) manufacture, that has grown to such proportions, is due to suitable wood and some important chemical discoveries in preparing the fulminate.

The *Engineer*, London, estimates that there has been expended on the principal ports of England the sum of 600 millions of dollars. There are in all 112 ports, of all kinds, in the United Kingdom, at which entered and cleared, last year, 712,952 vessels, having a tonnage of 167 millions. Out of 32 millions of tons cleared for foreign countries, 4,320,000 tons was to the United States, and of this 332,600 tons was to the Pacific Coast. The proportion is roughly one to thirteen, while our population is less than one to thirty, comparing the Coast population with the rest of the country. This indicates the importance of our foreign trade from this Coast, and how extensively the country is affected by any disturbance in our commercial relations abroad.

The Council of the Iron and Steel Institute, of Great Britain, concluded after the visit of that body to the United States in 1890, to publish a special volume relating to the data collected and observations made here during their visit. Sir Lowthian Bell, who has made an especial study of the resources and economic conditions of this country, was induced to prepare what may be called the economic section of this volume or report, and in this will be found the most accurate data respecting wages and cost of production that we can hope to have. It is impartial and without political coloring, as all other reports and statistics have been. Sir Lowthian says that an American family earns yearly $131.60 more than a similar family in England, and pays $95.15 more for the same necessaries of life, or their "living," as he calls it, showing a difference of $35 a year in favor of the American family before the present tariff went into effect. This will probably consume the $35, making the circumstances quite the same.

A good deal has been said and written about the British having ruined India. Even John Bright once said that India was a "sucked orange," but a country that increases in population at the rate of three millions a year is certainly not a despoiled one. The population of the Indian Empire is set down at 289,000,000. Pestilence and famine have nearly disappeared and internecine wars, which most of all hindered and ruined that country, have wholly ceased. Among all great works carried out there irrigation is a principal, not in respect to invested capital, perhaps, but as affecting the material interests of the people.

The Boston *Transcript*, on some authority not known, estimates that each year $30,000,000 worth of gold is used in the arts, for gilding and ornamenting, and that three times as much goes into jewelry as is coined. We have not much faith in these figures, but supposing them to be anywhere near correct, it is not hard to discover that gold has an intrinsic and commercial value, and not a representative one as is commonly contended. The same thing applies to silver, and if the fact could be shown, its value depends a good deal more on industrial uses than the stamp of mints. Both metals enter into the arts to the extent that can be afforded, and it is such use, with the cost of procuration, that determines the prices of all metals. It is true the adaptation to coinage imparts a portion, and perhaps a good deal of value to gold and silver, but the main fact of all is the small bulk of gold and silver in proportion to their commercial value. This is adaptation for money, so also is the non-corrosive quality, melting point and ductility.

The *Yoshino*, a Japanese war cruiser, built at the Elswick Works, Armstrong, Mitchell & Co., New Castle, England, heads the list at this time. Her displacement is is 4,150 tons, horse power 15,000, and speed 22½, or possibly 23 knots an hour. The armament and all appointments are of the highest class, and the firm, it is said, will undertake to build another cruiser of still greater power and speed if the Japanese Government will give such an order. The *Yoshino* is 360 feet long, other dimensions of the hull are not mentioned. The vessel was launched recently, and will soon be fully described. The present particulars are from *Engineering*, London.

The financial revolution in Australia whereby compensation is being made for a long period of "prices by law" and speculation induced thereby, will fall heavily on mining interests there. The Broken Hill mines, in 1889, reached a valuation of $125,000,000, and now has shrunk to $20,000,000, or 62 per cent. in four years. The Comstock mines, in Nevada, once reached the enormous valuation of $262,000,000, in 1875. In 1881 the valuation was about $7,000,000, or less than three per cent. of their value six years before. These things are not due to extraneous causes it is true, but were in Australia at least, in a great measure so. New countries, or rather inexperienced countries, whether new or old, are liable to great changes of prices, and financial panics, and commonly in proportion as their governments interfere with industrial and commercial affairs.

There is a question as to what color the vessels of the U. S. Navy should be painted, and whatever is decided upon should be other than the one this far adopted. A white painted ship is an anomaly by any rule of propriety, and previous to its adoption here, seems to have been confined to the French war vessels. It is a very visable color at night, when it is not desirable to have vessels seen, and less visible than dark colors in the day time, when it is desirable that vessels be seen. The conventional color, taking the world over, has been black, which corresponds, in some sense to the mission of these engines of destruction. The *Cushing* is to be painted dark green, but this looks shabby for some reason not easy to explain. It is unnatural for one thing. Green iron is repulsive to the engineering world at least, and black is, no doubt, the best color of all.

Those who, by some ratiocination of mind, can see happiness in implements of murder and destruction, do not, as a rule, pay much attention to such common-place matters as public improvements. They grow enthusiastic over Pacific coaling stations, and the annexation of Hawaii, torpedo boats, guns, armor plates, and the like, but as to public buildings, sewerage, water ways and such commercial things, these are not to be considered by the chivalry of our time. The waste of nations in war material and lost energy, would beautify, improve, and water the whole face of their countries in five years. If, for example, the wastes of the fighting department could be devoted to roads for a time, what a change could be made. A country with a navy and no roads is a pretty homily on human understanding. Present thought of this matter arises from the amount of public attention given to internal improvements in comparison to the destructive art.

The E. P. Allis Company, of Milwaukee, Wis., have constructed for the Chapin Mining Company, in Michigan, an immense pumping engine, with vertical cylinders, set tandem. reaching 54 feet high from the floor above the foundation. The high-pressure cylinder is 50 inches, and the low-pressure one 100 inches diameter, with a stroke of 10 feet, to use steam at 135 lbs. initial pressure. The engine alone weighs 600 tons. The *American Engineer and Railroad Journal*, from which these particulars are taken, says the engines are so arranged as to be driven by compressed air if that is desirable, a source for such power being near at hand.

In the International Geographical Congress, held in Berne, Switzerland, in 1891, there was passed unanimously a resolution requesting English scientific people to hereafter use only the metric system in their publications and work. The resolution, when offered, caused cheering for five minutes, and the fact indicates the sense of the world, as we may say, in respect to system of notation for weights and measures. To those interested in this subject we recommend that ten cents be sent to the secretary of the American Metrological Society, 41 East 49th Street, New York, for a chart of the metric system, that is prepared and sent out at its net cost by the association. It is stated in the *Mechanical News*, from which the above facts are taken, that parts of English wall charts are employed in schools to teach the metric system, and we infer that reform in notation has more promise there than here, where we took one step nearly half a century ago in our money system, and then stopped.

The steamers employed in what is called the channel service, in England, in times past, have not been of the highest class, and on the most frequented route, between Calais and Dover, they have been worst of all. This was in part due to shallow water in the harbors, and consequent low build that exposed the decks to spray if the boats were driven at high speed, hence they were slow. There seems now to be a change in this matter, at least in the Belgian boats between Dover and Ostend. One recently built by Denny Bros., of Dumbarton, runs at the enormous speed of 25.75 miles an hour, and is, no doubt, for her size, the fastest passenger steamer of the present day. The vessel was built for the Belgian Government that owns the railways on the continental side, and is the third one of high speed, the other two making 20 knots, or 23 miles an hour, in regular service. They are feathering paddle steamers.

The *Lucania* and *Campania*, recently launched, are together equal in cost and extent to one half of the Forth bridge, and when we consider that these masses had to be slid into the water without strains, or nearly so, the problem, as an engineering one, far exceeds that of the great bridge. These vessels weighed when launched about 10,000 tons each, and when we consider that two tons to a square foot is a limit of launching load, and that this enormous weight has to be borne on saturated and alluvial earth, the extent of the risk can be imagined. The launching angle is lowered as the weight of vessels increases. In the case of the two vessels named the ways were of oak four feet broad. The slope is from $\frac{3}{8}$ in. to $\frac{5}{8}$ in. per foot, and the velocity aimed at from 9 to 12 feet per second. These ships were built at Govan, near Glasgow, and launched into a river almost wholly an artificial one, made by hand, so to speak. The building foundations laid were made strong and large enough for vessels 700 feet long.

The agricultural colleges, founded all over this country, especially in the Western States, will before long begin to bear fruit in the way of inquiries into the economic relations of this industry to others, not only in respect to possible profits or earnings, but in legislation, State and National. The status of farming, in respect to other pursuits, depends on education, and in this respect farmers have been at a disadvantage, not from want of natural capacity, but the circumstances of their calling. An International Agricultural Convention has recently been held in London, and while the proceedings were not characterised by the learning of the British Society, they were, nevertheless, rational, reasonable, and wide reaching in some respects.

LITERATURE.

Pumping Machinery.

BY WM. M. BARR, PHILADELPHIA.

This work, we will say at the beginning, in so far as usefulness, prevents all comparison with treatises on pumping that have preceded it. It is intensely practical, and at the same time comprehensive, covering the whole field of modern practice in this intricate branch of engineering work.

It is strange that a thing which seems inferentially so simple as impelling fluids, should involve more intricate problems of both construction and operation than any other branch of industrial science. The converse, or the impelling action of elastic fluids, including steam and pneumatic apparatus, when coupled with thermal problems, may be a wider field, but with this exception, if it be one, the hydraulic engineer has the most intricate field in which to labor.

In the present case the author brings to his aid, three conditions or qualifications seldom combined — a thorough knowledge of pumping, a wide experience in constructing pumps, and a complete faculty of setting out his knowledge and experience in perspicuous terms. We may also mention a complete history of the art, back as far as there is any use in following it, or as we may say, as far as any useful thing can be learned.

Chapter IV on valves, is one of the most complete, and is indeed, the first comprehensive essay on the subject of water valves that has appeared, but there is little use in selecting chapters for notes, all are good unless it be the one on centrifugal pumps.

In this section the author has carefully collected such data as was available, and that is not much, and naturally falls into the error of quoting from various opinions or rules laid down, which if not obsolete, are no longer regarded as authority, on this Coast at least, where centrifugal pumping has reached an advanced development.

The Appold and Parson's experiments are given, both of which should be considered as relating to reversed "turbine wheels," also other matter, such as relates to centrifugal and tangential energy, which the author may do well to revise for a future addition.

The article on expansive direct-acting steam pumping engines, Chapter XXIII, is one of much interest. The term "high-duty" as here applied, is confusing, but means, as we understand it, increased efficiency, attained by compensating pistons or radial gearing to accommodate expansion in the steam cylinders.

The history of such apparatus is given, including the systems of Cameron, Davies, Davy, and Groshon, in a very impartial manner, and should command attention on this Coast, where, so far as we know, no attention has been given to compensating devices of this kind.

The work is confined mainly to American practice, with, however, mention of Professor Reidler's researches and methods, now commanding a good deal of attention in all countries. The publication is timely, because we are certainly entering upon a considerable reform in increasing capacity, if not in efficiency, of pumps of all kinds. We commend the work to our readers. It contains 448 pages, with 250 engravings and plates. It is published by Messrs. J. B. Lippincott & Co., Philadelphia, and sold here by their agent Joseph A. Hofman, 207 Montgomery Street. Price, $5.00.

Geological and Solar Climates.

BY MARSDEN MANSON, C. E.

To those who are acquainted with the author of this work, and his professional activity and services, it is a matter of astonishment how he found time and opportunity for the study that is here set forth.

Mr. Manson was a student with, and for some time engaged with Lieut. W. F. Maury, which must account for the interest in terrestrial physics which the present and other writings of his on the subject gives evidence of.

It is several years ago when a collation, to so call it, of widely observed phenomenon and correlated geological facts, opened up to the author, the present theory of thermal physics, which has attracted a great deal of

attention throughout the scientific world, and which, as he illustrates it, furnishes a keystone for an incomplete arch of conjecture that had preceded, respecting the cause of the glacial period of the earth's history, and the various attendant conditions geological, geographical, and climatic, that were involved in that obscure but obvious stage of the earth's evolution.

The title chosen for the essay, while literally descriptive, will not convey a true idea of the theme. "Climatic," meaning remote cosmic changes that have preceded and determined present climates and other physical conditions of the earth, and perhaps of other planets.

The work permits of no review, except by comparison with cognate theories by other scientific men, and of such theories but little is known in a popular or even in a scientific way, and it would be a hollow pretense to venture here any opinions respecting the correctness of Mr. Manson's views. We feel more competent to judge of the city's sanitation, to which Mr. Manson's professional attention is, happily, just now directed.

The work is sold by Mr. William Doxey, 631 Market Street, San Francisco. Price, 75 cents.

Transactions of the American Institute of Electrical Engineers.

APRIL 1893.

The importance of this society is indicated by the maintenance of a monthly serial of proceedings, containing in the present case more than 200 pages of matter.

A short paper of much popular interest is one by Mr. Townsend Wolcott, on "An Early Dynamo," reciting certain facts in the history of generators in 1867, and an account of an electric company organized in that year, of which Horace Greely was a charter member, also Professor Chas. A. Seeley, who was the scientific expert. Of the seven trustees only one is now living, Mr. E. A. Beach of the *Scientific American*.

The main paper of the month is by Mr. A. E. Kennedy, on "Impedence to Electric Currents," too technical for notice here.

The "transactions," if furnished to members, must fully represent the subscription dues, and the organization is much to be praised for the amount and valuable nature of its published matter.

Michigan Reports.

We have received from Henry A. Robinson, Esq., State Commissioner of Labor for Michigan, the tenth annual report of his Bureau, and must defer farther notice until examining the volume, which contains 1,350 pages. We have ventured the opinion that Mr. Robinson, among the various State Commissions of Labor, has contributed the most useful matter, and will now add that his services should be national, or even international, a view that will be endorsed by as many as have knowledge of his labors, and the additions made to this now greatest of problems in the human economy. The present report will be again noticed.

Consular Reports.—Nos. 147, 148, 149.

DEPARTMENT OF STATE, WASHINGTON.

The diversity of matter collected, and transmitted, by the American Consuls is indicated by a paper contributed by Consul Edward Bedloe from Amoy, China, in the December issue, No. 147 of the above reports, entitled "Chinese Curios." A section of this paper on "Josses," has been selected for republication in some future number of this Journal.

The report of January, 1893, No. 148, is taken up mainly with papers on industrial labor subjects, profit sharing, and the like, and as such is an addition to a kind of *ex-parte* matter of which we have already a great plenty.

The subject of wages, cost of living, and so on, are meaningless unless taken in connection with production. It is like consulting one side of a ledger account. The "rate of wages" indicate a social, but not an economic condition. The wages "cost" of commodities is the main thing in economical research, and this seems to be carefully avoided in all writings of the kind such as have been presented for four years past.

We do not believe that any harm can come from true statistics, or facts of any kind, but that these one-sided labor reports are now full enough until we know what the labor produces. The price of a thing means nothing, except by comparison with its value, and the price of a day's work has in the abstract no determinable value.

For the rest, this number deals with the Canals of Canada, and South Amer-

ican Trade. Consul A. Y. Dougherty, at Callao, Peru, writing of the trade of that country, says the growing of swine has been promoted by a heavy duty on American lard, and a few lines later on says of American trade that "with steamship communication and rates that compete with other countries, the problem is solved at once," we need not point out how these two propositions do not fit together.

Situated as we are, much nearer Peru, on the same continent, and with steam communication there, we manage to sell to that country one sixth as much as Germany, that is 3,000 miles further away, and much less in proportion compared to England and France, and this small amount made up mainly of "notions."

The report is extensive and carefully made up, and is a story of "protection" both here and in Peru; protection to carrying companies mainly. The consul says that the cost of freight from the United States is a main impediment to our trading in Peru. Hardware and the like comes from Europe for 20 shillings a ton, and costs from New York 45 shillings a ton. The distances are more than as two to one in favor of this country, the rate as nine to four, and one must conclude that carriage is about four times as expensive from this country.

By the Isthmus the same rates exist, the American rate being two to one, for half the distance. The Pacific Mail have a monopoly of this trade. One of our San Francisco firms has been trying for some time past to do business in Callo, but finds it impossible in most cases, because of the rate charged for transportation. Large quantities of packed fruit could be sent from here to Peru, as well as other South American countries, if it were not for tariffs and monopolies of one kind and another.

Alternating Currents of Electricity.

BY GILBERT KAPP, C. E.

The author of this work is so well known in connection with modern electrical literature and research, that one may safely estimate the value of any writings of his, passed through so critical a source as the Institute of Royal Engineers, England.

The explanations of alternating currents that precede the author's mathematical treatment of the subject, are perhaps the plainest ever presented, and as plain as such explanations can be, because none can expect that the phenomena and nature of alternating currents will ever become popularly understood.

The terminology as indicated in the title above is admirably plain and chosen, and the later chapters, including remarks upon various constructive features of apparatus can not fail to be of much value to those engaged in making and erecting alternating apparatus for any purpose.

The introductory remarks begin with some statements of much novelty, as follows:

"When we think or speak of electric currents, we are accustomed to regard them in the light of material currents, of something which flows along a path formed by the conductor, and has, therefore, a direction. We say that electricity flows along a conductor or through the conductor from the place of higher to that of lower potential; in the same way that water will flow from the higher to the lower level through a pipe. Such a view is, of course, purely conventional. As a matter of fact, we do not know whether it is the positive electricity that flows in a given direction, or the negative electricity that flows in the opposite direction, or whether both electricities flow simultaneously in opposite directions, or whether there is any transfer of electricity through the wire at all, Indeed, according to modern views, there is merely a transfer of energy, but not through the wire, the transfer taking place throughout the space surrounding the wire. To talk about an electric current flowing through a wire, may therefore be an unscientific way of expressing our meaning, but it is a very convenient way, and therefore, generally adopted."

The book is published by the W. J. Johnston Co., Times Building, New York. Price $1.00.

Hand Book of Wiring Tables.

BY A. E. WATSON.

A convenient and concise little treatise, containing rules for electric wiring, that practical part of the art in which a set of rules, tables, and printed instructions are most valuable. It is published by the Rubier Co., at Lynn, Mass., and is one of a series of text books on electrical subjects that will do much to spread knowledge of the art. The present one costs one dollar, is for sale by Messrs. Osborn & Alexander, in this City, and is well worth the money to any one dealing with electrical matters.

The Universities of California.

The annual "Registers" of the University of California, and the Leland Stanford Junior University, come to hand, containing in each case, evidences of extension and growth.

The Stanford institution especially, which naturally shows a very great increase for the second year, amounting to 205 pupils, and a total of 764 enrolled at the present time, or for the academic year to follow.

The University of California has a total enrollment of 1,082, in the main institution at Berkeley, and colleges in San Francisco, making for both universities, 1,846 students.

The principal facts in the history of the State University were set forth in previous notices in this Journal, and there is only to mention this year, a considerable extension of the buildings, especially for the College of Mechanics, plans and descriptions of which have been published during the past year.

The endowment of the Stanford University includes the Palo Alto Estate of 8,400 acres, the Vina estate in Tehama County, 59,000 acres, of which 24,000 are in vineyards, and the Butte County estate of 22,000 acres, a wheat farming district; total 165,000 acres of land.

The extent of these higher class educational facilities is far beyond the proportion that the population of this State bears to other sections of the country, and is characteristic of the tendencies of the age. What its future effect will be, is not easy to conjecture, except that a marked influence should appear in the social conditions of the people in the near future.

The pursuits that are purely or mainly manual and routine, such as do not bring into use the earning power of an education, are disappearing nearly in the same proportion that education increases, and to paraphrase one of Carlyle's inimitable epigrams: "The true epic of our time is not hands and the man, but machines and the man."

Engineering.

No 1,425 of *Engineering*, London, April 21st, is, perhaps, the most remarkable number of a technical journal that has ever been issued, and indicates the vast resources of that serial. It is divided into two parts, one being an epitome of the history of trans-Atlantic steam navigation, with an exhaustive account of the great Cunard steamers *Campania* and *Lucania*; and the other an illustrated description of the World's Exhibition at Chicago.

The issue contains 144 pages of matter with more than thirty full-page plates, among these two double-page illustrations of the *Campania's* engines, wood engravings that alone must have cost the price of an ordinary number. It would be a matter of interest to know the cost of this issue of *Engineering*, not in a commercial sense, but to show the resources of technical literature at this day, and the rank of industrial interests in that field.

Sketching Books.

Messrs. Spon and Chamberlain, of New York, have been preparing books for sketching, in which the paper is ruled in spaces one eighth of an inch wide each way, so that in sketching one has a scale by which proportions and dimensions are determinable without instruments.

The idea is a good one, especially for mechanical work, where each eighth can be considered an inch, producing a sketch of one and one half inches to the foot, or for large objects, a house for example, the scale can be assumed as one eighth of an inch to a foot, producing a scale of 96 to 1.

The principal feature to be mentioned concerning these sketch books is the wonder that they have not been furnished before. The present size, the standard one, is 5×7 inches, intended for carrying in a pocket and the price 25 cents.

Electric Tables and Memoranda.

Messrs. Spon & Chamberlain, of New York, send a companion piece to *Engineer's Tables*, noticed last month, similar in dimensions, watch pocket size it may be called, containing electrical tables by Prof. S. B. Thompson — an unique and no doubt useful book of reference, that might be one of a dozen to be carried in one's pocket without inconvenience.

These little books are typical of the division of technology in our time. Not long ago one could carry in their vest pocket a *vade mecum* of the useful arts, with a few essays thrown in. Now, a whole library is required, and segregation is the rule. The present example costs 50 cents.



THE EXHIBITION BUILDINGS AND GROUNDS AT CHICAGO.

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"INDUSTRY."

JOHN RICHARDS, EDITOR.

ISSUED MONTHLY BY THE

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SCANDINAVIAN DISCOVERY OF AMERICA.

BY THE EDITOR.

It has been announced that the Danish Government will send to the exhibition at Chicago, the old Icelandish records containing accounts of the Scandinavian settlements on the American continent, nine hundred years ago, in Greenland and on Massachusetts Bay.

These documents, which we will refer to more particularly in a future place, are considered of great value, and certainly are so in an archæological sense, and to the Scandinavian people especially, as evidence of a very interesting portion of their early history. These early settlements of the Norsemen in Greenland, followed close upon some very marked events in their own land, to which we will briefly revert, and in doing so will remark in respect to the old "sagas," where the circumstances are recorded, that while these contain the usual poetic license of elastic imagination in all that pertains to personal matters, feats of arms, and so on, in respect to facts of a national or tribal nature, their historical truth is not questioned. Details may be colored and warped, but the main facts are so well supported by concurrent testimony that no history of the period, even in the Latin tongues, should command more confidence.

It is not generally known that the early history of the Northmen was to a great extent preserved in Iceland, and as we may say, was preserved there only, and brought to light in recent times, as will be explained further on.

About the year 806, Harold Haarfagr, "Fair-haired Harold," as we would say, desired to wed a princess of Sweden, Gyda by name, but he being but one out of many tribal kings in Norway, only a "Jarl," or Earl we call it now, the fair princess told him to go home and conquer his country, reduce the other jarls to subjection, as the Danish monarch Gorm had done, and become a real king, then she would wed him.

This struck Harold favorably, and he made a vow that he would not have his hair cut again until he had crushed out the rival jarls and reduced his kingdom to a complete whole. This he did in a vigorous and rapid way, scattering the other jarls far and near; some of them sailing away to Iceland to escape him, and founded there a colony which is now about 1,014 years old, counting from the time of complete organization there.

The thousand years' feast to commemorate the event occurred, as now remembered, in 1879, when we were in Scandinavia. The King of Denmark went to Iceland with many of his court and numerous visitors from various parts of the Scandinavian countries, with this, however, we have nothing to do at this time.

The fleeing jarls and their people 1,087 years ago took with them all kinds of records, runic writings, songs, traditions, and mementos, that, as before mentioned, have become in recent times a principal clue to early Norse history. It was from Iceland that Greenland was settled, and America discovered, the accounts of this coming down with the other records from the Arctic island.

In the middle of the seventeenth century, Christian VII, of Denmark, in order to arrange and preserve these old records, which had been translated into Latin, when translated at all, engaged the celebrated historian Mallet to write a history in French that would embrace all the leading points of the Runic writings, sagas (songs) and other such data as then existed, was known, or procurable. This undertaking was carried out in a very able way by the celebrated French historian, and Bishop Percy, of England, undertook a translation of the book into English, a work which appeared in 1770, and is now known as *Mallet's Northern Antiquities.*

Bishop Percy was a profound scholar, gifted by nature, and learned in all that enabled an understanding of the subject, but like his distinguished predecessor, lacked much data, especially of a philological kind that began to appear soon after these histories were written, but the work was revised and reissued in 1847, by J. A. Blackwell, Esq.,

of London, who brought to bear upon it an erudition commensurate with the task, and the result is that this work is a standard in all that pertains to early history of Scandinavian countries or the Northmen. The accounts therein given of the expeditions that reached the American continent, are accepted the world over as authentic, and have been incorporated into the standard school histories of most countries, including our own.

There is no wonder that sending these old records from Denmark to Chicago will be an event of much interest, and that great care will be taken in their conveyance, preservation and return to Copenhagen.

Coming now to the particular events that are of most interest here, these are recounted mainly in the saga of "Erik the Red," thus spoken of in *Mallet's Northern Antiquities:*

"The two most important documents published by Mr. Rafn* are the sagas of Erik the Red, and of Thorfinn Karlsefni, which were probably first committed to writing in the twelfth century, or about four generations after the events recorded took place. The manuscript of the latter saga, made use of by Mr. Rafn as the basis of his text, is on vellum, and bears internal evidence of having been written at the close of the thirteenth, or beginning of the fourteenth century. The saga of Erik the Red forms a part of the beautiful vellum manuscript called the "Codex Flatoiensis," which is a collection of sagas transcribed from older manuscripts between the years 1387, and 1395; that is to say, a century before the discovery of America by Columbus."

About the year 950, or a hundred years after the settlement of Iceland by the jarls that Harold Haarfagr had driven out of Norway, a Norse chief called Thorvald was banished for three years for killing some one in an irregular way, and went to Iceland. He had a son called Erik, who in turn got banished from this new country for a similar offense, not uncommon at that day, and not daring to return to Norway, he set sail around the north-east coast and came upon Cape Farewell, and finally to Greenland, where he settled for good, on the eastern side of Baffin's Bay. At the end of the three years he returned to Iceland and took out a number of settlers to his Greenland colony on Baffin's Bay.

In 997, his son, Lief Erik, or as it would be written now, "Lief Ericsson," sailed back to the old home in Norway, and was well received there. He adopted the Roman faith, and then returned to his father's colony in Greenland, and proselyted the people there,

*A celebrated Danish archaeologist and philologist of modern times.

who readily adopted the new religion instead of the old Odin and Thor horse-eating faith of the Norsemen.

The settlements in Greenland, two of them, continued to grow, one having 90 farms and four churches; the other 190 farms, two towns, eleven churches, a cathedral and two monasteries, with a population of not less than 1600, possibly 2000, for these Norse families were large at that day. The first Roman bishop was ordained in 1121, the seventeenth and last one in 1404, or 283 years later, so this settlement in Greenland was quite a nation, and at least as old as our own is now, but it disappeared; how, no one can tell.

The records are clear for about 400 years, and then the whole was blotted out, mainly it is believed by starvation, and by a system of very perfect "navigation laws," invented even at that remote day, that forbid the vessels of all nations from landing there. It is commonly thought that the people, when reduced by famine, were totally destroyed by the Esquimaux Indians, with whom the colonies were always at war.

So completely was the country destroyed that the search for them or their relics in the sixteenth century was fruitless. In 1771 a new colony was founded near the same place, and the old ones have since been found, with all kinds of sacred and other remains. Eleven of the churches have been brought to light, and much of their paraphernalia, such as could endure the elements, has been preserved.

We will not detain our readers with this matter. It is authentic, and is no doubt more so than most history of the kind, covered up in the glamour of war and the prowess of persons.

These old Norsemen had slight respect for kings and great people, such as form the burthen of ancient or even modern history. They have always been a race of popular government, where nothing but merit or the necessities of governing gave power to one man; hence their history is almost alone in the world, a history of the people, and not of kings and potentates.

Among those who went with Erik the Red to Greenland, was Herwulf, whose son Bjarni went on a trading voyage to Norway in 986. On his return, by the way of Iceland, he found his people, who had been visiting there, had returned to Greenland. He started there too, but got lost and drifted in fogs eastward and south along the coast for a long time, finally saw the land, which he approached, but found it low and covered with forest. This he knew was not Greenland, and so set sail again for two days, and then

approached the land to find it again covered with trees. He then continued for three days, with a north-west wind, and came to a lofty island where the shores were covered with icebergs and glaciers. A third attempt brought him to the Greenland colonies in Baffin's Bay. This voyage of Lief's became a much-told story. He had evidently come down around the coast of Labrador, perhaps around New Foundland, or even Nova Scotia.

In the year 1000, or 893 years ago, he fitted out an expedition to farther explore this new country, and sailed way to the south-east. His first find was a land covered with broad, flat rocks, which he named "Heluland," and continued to the south, coming to a country with sandy cliffs, but covered with wood, which was named "Markland," or woodland. He next passed an island, which he left to seaward, and entered the mouth of a river, sailing up on the flood tide, which here rose to a prodigious height.

Here Lief and his crew wintered, constructing comfortable houses on the land, and this was the first settlement of white men in this country. There was plenty of salmon, plenty of grass, and no severe weather such as these people were accustomed to. The grass remained green all winter, another marvel to them.

There were thirty-five people in Lief's company. These were divided into two sections, which took turns at guarding the settlement and exploring the country around them. With them was a German named Tyrker, who one day while in the woods discovered some wild grapes, and became so excited that his comrades thought him crazy. He had found here a fruit known to his boyhood in Germany, long forgotten, but here again real, and no wonder he indulged in some antics over the matter, getting his face smeared with grapes, which the Norsemen mistook for blood. This circumstance gave the name of "Vineland" to the country.

In the spring of 1001, Lief sailed home again to Greenland, and in 1002 his brother Thorvald set out again with thirty people in the same vessel, and came without accident or difficulty to Vineland. Thorvald sent parties to the south along the coast, and found a beautiful country, covered with forest, but neither men nor animals.

On Thorvald's return journey to Greenland in 1004, he had some mishaps with his ships and had to land for repairs, and while on shore discovered nine Esquimaux, eight of whom were killed. The next day a large force of these Indians returned and attacked the ship with arrows, killing Thorvald, who no doubt deserved it. He was buried on a cape called "Crossness," or Cape Cross. The

company then returned to "Lief's Booths," as the settlement in Vineland, was called. In 1005 he returned to Greenland.

Then Thorstein, a third son of Erik, set out for the new country, taking along his wife, Gudrida, and twenty-five men. They were unfortunate, however, and were tossed about nearly the whole summer by adverse winds, and in the autumn went in to the shore, established winter quarters, where many of them, including the chief of the expedition, died of some contagious disease during the winter.

In 1007 a large expedition left Greenland for Vineland. It consisted of three ships and 160 people, including a number of women. They also had animals for breeding, and various kinds of equipment such as existed at the time and would be required in a new colony. It would be tedious to recount the various events of this expedition on its way to the warm country. They finally came to a large river that flowed through a lake to the sea; its mouth obstructed by sand banks, so that it could be entered at high water only. Here corn grew wild on the land, and vines in the hills. No snow fell in winter, and the cattle remained out in the fields.

Here for the first time they came in contact with the North American Indians, who came near making an end of the whole colony. The Norsemen were driven off to sea, and in their wanderings one ship actually crossed the Atlantic. It was attacked by teredo worms and sank on the Irish Coast, some of her people reaching Dublin in a boat.

There were, after this, other expeditions from Iceland to Vineland, and the regions south of there. There are accounts of many romantic and some tragic events, characteristic of the time, but if one considers civilization elsewhere nine hundred years ago, the wonder is that any people living in 65° North could have attained the order, enterprise and intelligence that existed among these Norsemen.

Later on other journeys to the new land were made from Iceland, Norway, and Denmark, in 1121, 1285, 1290, 1295, and 1347, but there is perhaps no use of more recital to show that for a period of four hundred years the Northmen maintained nearly continuous intercourse with this country, down as far as Massachusetts Bay, and possibly far to the south of there.

There is also evidence of their intercourse extending to Ireland. In an old geographical treatise in Iceland there is the following translation from the sagas.

"To the south of inhabited Greenland are wild and desert tracts and ice-covered mountains; then comes the land of the Skrællings,* beyond this Markland, and then Vinland the Good. Next to this, and somewhat behind it, lies Albania, that is to say, Hvitramannaland (*Whitemansland*) whither vessels formerly sailed from Ireland. It was there that several Irishmen and Icelanders recognized Ari, the son of Mar and Katla, of Reykjanes†, whom there had not for a long time been any tidings of, and whom the natives of the country had made their chief. The Landnámabók also states that Ari Marsson was driven by a tempest to Hvitramannaland, and detained and baptised there; and we are told in Thorfinn's saga that the Esquimaux children taken in Markland declared that beyond their country lay another, the inhabitants of which wore *white* dresses and bore flags on long poles."

"This statement is obviously of no value in itself, but remarkable for the conclusion drawn from it by the Northmen, that the country thus described must necessarily be Hvitramannaland, which shows, at all events, *that at the period the saga was written* the existence of such a country was a fact generally admitted."—*Mallet's Antiquities.*

It is interesting to study the notes and criticisms of the learned authors mentioned at the beginning, respecting these old records, divergent of course, but in no way disputing the main facts set forth, nor is there anything strange in the matter. The distance from Iceland to Greenland, and from there between the points visited on the American coast, is much less than between Norway and Iceland.

History goes to show that Columbus visited Iceland before his voyage of discovery to the West Indies, and there learned of the existence of the new warm land. Of this circumstance we have no accurate account. There is, indeed, no kind of information more difficult to get at than antiquarian research. No two people ever agreed on a matter that involved inferences. Each wants a pet theory or conjecture of their own, but the main facts in this discovery of America are as nearly undisputable as any chronicle of the period can be, and need not be disputed.

Hero worship is a peculiar trait of the human mind. It finds its most marked expression toward sacred things, but also demands human heroes, people of our own kind that can be set up for veneration. Among these is Columbus, whose life and acts are set forth in a coloring of fiction as well as fact.

* Esquimo Indians. † Supposedly Reikiavik, Iceland.

SOME PROBLEMS IN PUMPING FLUIDS.*

By J. RICHARDS, Mem. Tech. Soc.

The writer, in an experience extending over ten years past, has met with some problems in raising and impelling water, that it is believed can be presented here with advantage. At first it was thought that these problems could be presented with both graphical and mathematical illustrations that would, no doubt, have added a good deal to the value of the paper, but on consultation with the Secretary, Mr. von Geldern, and with Professor D. E. Hughes, it was found that previous to treatment in this manner a certain amount of fact and data of various kinds must be prepared as premises. The reason for this will appear further on.

In raising and impelling water we employ pumps of various kinds in respect to arrangement and construction, but all coming within three classes familiarly known as piston pumps, centrifugal pumps, and the positive rotary kind. There are other modifications that do not seem to come within these classes, such as ejectors and pulsometers, but as ninety-five per cent., if not a larger proportion of all pumps in use, belong to the two classes first named, piston and centrifugal, the present remarks can be confined to these. As between these two types there are at least twenty times as many piston pumps as centrifugal ones, so the former comprises ninety per cent. of all in use.

To present as soon as possible some clue to what we are to consider this evening, if one examines the trade circulars relating to these classes of pumps some queer facts will appear. Confining such examination to what are called commercial pumps, that is excluding special pumps, such as are made for public or municipal water supply and like purposes, it will be found to begin with that the duty of the two kinds of pumps are about as ten to one in favor of the centrifugal type, if we compare them on the basis of their bore, diameter, or flow capacity. For example, a piston pump of 8 inches bore is set down for a duty of 120 gallons per minute, and a centrifugal pump of like bore at 1,200 gallons per minute, the proportion being ten to one. Remember this comparison is made on the basis of the flow capacity, and section of the water ducts through these pumps, and has no reference to their efficiency or con-

*Read before the Technical Society of the Pacific Coast, June 2, 1893. Reprinted by permission.

sumption of power in proportion to the work performed.

We will next compare them in respect to cost, or investment as water-raising mechanism or implements, including some means of connecting to motive power. This latter would have to include in the case of piston pumps either a steam engine directly connected, or a crank shaft and other gearing, so that the cost of the two pumps when compared on the basis of their bore will not vary much from two to one if we consider the weight of material and the cost of construction. The flow capacity in the two cases, as we have seen, is as ten to one, and this, qualified by the first cost of the two machines, shows that a piston pump costs for a given volume or duty twenty times as much as a centrifugal pump.

In respect to efficiency, or the consumption of power in proportion to the work performed, and still confining the comparison to the commercial classes of pumps, the difference in efficiency is also in favor of the centrifugal type. An evidence of this lies in the fact that the trade circulars issued include the efficiency of centrifugal pumps but not of piston pumps. Contracts made for centrifugal pumps nearly always include stipulation as to the duty to be performed with a given amount of power, but this is not the custom in respect to piston pumps of the commercial class, and their efficiency is, no doubt, much less.

There is plenty of data respecting centrifugal pumping, but not of piston pumps of the class we are now considering, and such as are commonly supplied for purposes such as centrifugal pumps are employed for, in irrigating works for example. The operating conditions, such as endurance, liability to derangement, steadiness of motion, with other circumstances of use, are in favor of the centrifugal pump. It is, of course, understood that in such comparison there must be taken into account limitations of head or pressure, and other things, that prevent the use of centrifugal pumps in many cases, but this is not important for our present purpose, which is not to frame an argument in favor of centrifugal pumping, but something quite different, as will presently appear.

This comparison has been made to show the economical difference between continuous and intermittent action, which is the chief distinction between these two methods of pumping. There is no reason why 1,200 gallons per minute could not pass through the piston pump the same as it does through the centrifugal one, if there were not limitations of some kinds that take away nine tenths of the capacity of the piston pumps.

As at first remarked, this difference between the two methods of pumping seems to rest in "constant flow" in one case, and "intermittent flow" in the other case, which is mentioned at this time in advance of its proper place to enable a better understanding of some further comparisons to be made. By examining lists of centrifugal and piston pumps it will be seen that the suction and discharge pipes of the former are made of a larger diameter than the pump's bore. In this State the smaller class of centrifugal pumps are usually made with discharge pipes having four times the capacity of the pump nozzles, the suction pipes the same. To quote an exam-

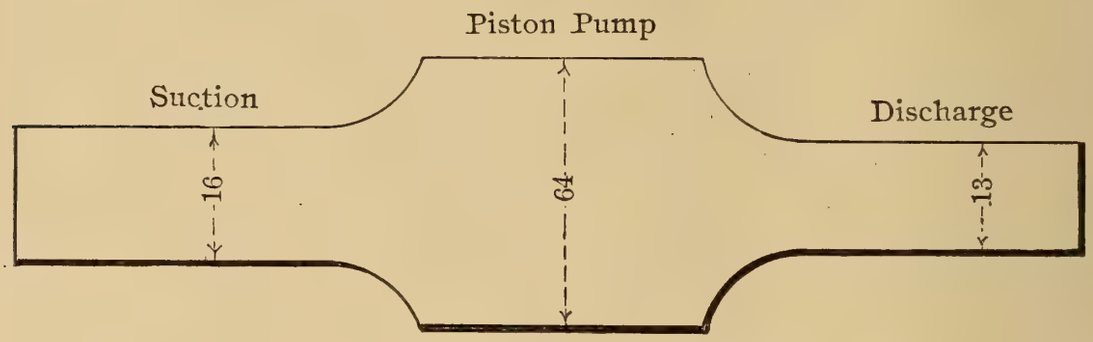


Fig. 1

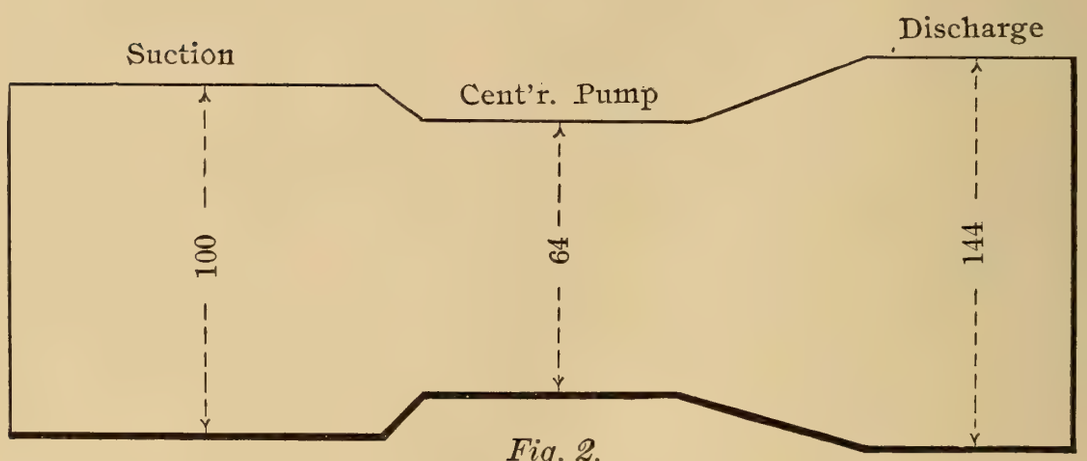


Fig. 2.

ple, or several examples now in mind, the diameter of the pump nozzles are five inches; diameter of the uptake pipes, 10 inches. Suction pipes, of which there are from two to four, 6 inches; suction inlet to pumps, 8 inches. With larger pumps these proportions do not hold, but the pipes are in all cases made larger than the pumps to which they connect.

Turning to piston pumps we find the pipes with capacity only a third or fourth as much as that of the pump's bore, or, comparing with centrifugal pumps, about one seventh as large, and are in proportion to the flow in the two cases. Here then is an anomally, two

machines for impelling water under like conditions for average heads, one costing twice as much as the other and performing one tenth of the duty. Behind this must lie some potent feature of method or operation which we find primarily in the difference of velocity at which the fluid passes through the pumps, and from that can lay down a first postulate as follows:

The dimensions, weight, and first cost of pumping machinery are inversely as the velocity with which the water passes through it.

The velocity which we have seen is as ten to one, or thereabout, can be illustrated in the two cases by diagrams, as in Figures 1 and 2, where the ordinates represent the diameter or capacity of the water ducts in the suction pipes, pumps, and discharge pipes as taken from actual practice here in California.

These comparisons have been dwelt upon for the purpose of showing the low duty performed by the reciprocating piston type of pumps, and to set forth in as plain a light as possible their possibilities under a continuous flow, as illustrated by comparison with other pumps of the constant flow type.

This branch of the subject can now be left to trace out the causes of this difference, and why, as in the case of piston pumps, water is moved by "jerks," so to call it. This limitation is found in the variation and cessation of velocity of the water in the pumps and usually in the suction pipes, and when considered as a dynamical problem the wonder is that a flow of even 1.5 feet per second can be attained in this manner of pumping.

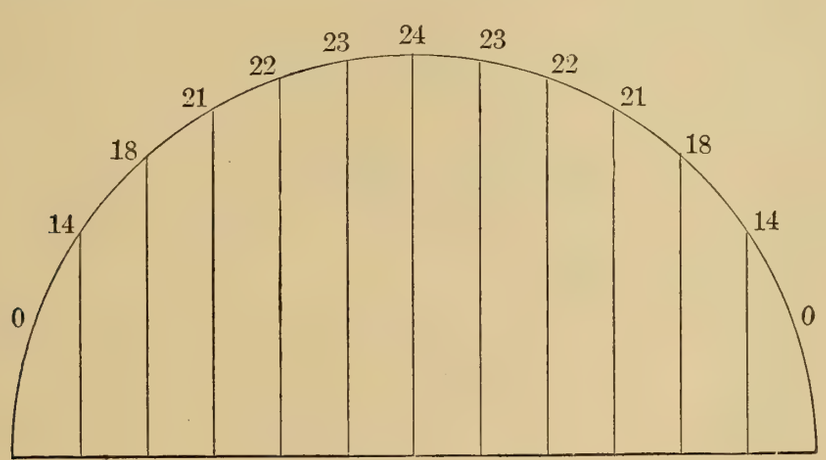


Fig. 3

The ordinates in Fig. 3, and the figures set opposite, represent one stroke of a crank-moved pump piston, showing the changes of velocity, and from this we can derive a second postulate as follows:

The limitation of duty in reciprocating piston pumps amounting to from eight to nine tenths of their normal capacity is due to intermittent and irregular flow.

It must not be imagined, however, that a crank piston pump operates under a regular cycle of pressures, as indicated in the diagram. The actual performance is much worse, and indicator diagrams taken from the pump chambers are so imperfect as to suggest a much greater loss of capacity than really occurs.

Reverting further to this matter of irregular flow or velocity, and the important part it plays in pump performance, a good way to appreciate the fact is to imagine the same method applied to the movement of weights in other cases. Let us suppose, for example, a railway train, a boat, or an elevator, propelled or moved in this manner, and the mean velocity reduced to one tenth by such movement. The proposition is too absurd for consideration, and yet this is precisely what we do in pumping, and in the case of nine tenths of all pumps in use.

It should be mentioned that in the case of direct-acting steam pumps the movement of the steam piston accommodates itself in a degree to the resistance of the water, producing a diagram different from Fig. 3, but the limitation as to velocity is nearly the same in practice as in the case of pumps driven by crank movement.

Now, it may be asked, what practical result can there be in view in thus presenting this matter? Can piston pumps be made to operate by continuous flow, and how is it possible that a class of machinery that has had the attention of the most eminent engineers for centuries past should operate under such unfavorable conditions? This brings us to the second section of this paper.

Notwithstanding this subject is new in so far as common practice, it is not new in respect to all practice, and there are unmistakable signs that very soon there will be a considerable change in the methods of pumping.

In no other portion of this country, and perhaps not among an equal population in any country, is there so much investment and interest in raising and moving water by pumps as on the Pacific Coast. It may also be claimed that, down to the present time, no other part of the world has contributed more to this branch of engineering work. Designs and modifications of pumping machinery made here have attracted attention and approval all over the world, and it will be anomalous if this matter of increased capacity is not taken up, and pressed forward here the same, or to a greater

extent, than in other places. To this time this is not the case, and the present purpose is to call the matter to the notice of our members, among whom are a large number connected with, and favorably known, as designers and makers of pumping machinery.

In no other place is there such an amount of accumulated data respecting pumping against high pressures. Centrifugal pumping machinery has been improved beyond what has been attained elsewhere in respect to efficiency and other working qualities. The adaptation of direct-acting pumping engines to marine purposes, and especially to war vessels, by G. W. Dow, of this City, is a distinctive advance on what has been done in any other place or country. These improvements, which do not much concern the general public, have not been given out in the usual manner. Under these and other circumstances to be hereafter mentioned, it is a wonder that more attention has not been given to what is going on elsewhere, and of which some notice will now be made.

Professor Riedler, of Berlin, Germany, about ten years ago began a series of investigations respecting the action of piston pumps that with some other experiments of the kind is destined, no doubt, to cause a great change in practice, indeed has done so at this time in Europe, and is working its way here in a significant manner.

Professor Riedler's indicator diagrams taken from common pumps are "monstrosities." No one would suspect that such forces as here appear existed in pumps of any kind. Mr. J. C. H. Stut, one of our members, has loaned a copy of Riedler's *Indikator Versuche aus Pumpen*, which can be examined by the members at the close of the paper. These researches occupied a period of many years, and led to the appointment of the author to a high scientific position in Germany, and also to his being associated as consulting engineer in the celebrated works in Paris for distributing power by compressed air.

The result of Professor Riedler's researches and improvements was to increase the flow of water through piston pumps to *five feet per second*, or about three times the former velocity, without the least shock or jar. This is a wonderful result, one that is far beyond question at this time, and attained by changes that are in comparison with the results, simple and inexpensive. They consist in positively operating the valves by mechanism independent of the action of the water, and in so constructing the water ducts that there is but little change of velocity as the water passes through the pumps. This work of Professor Riedler's is one principal fact in the history of

this matter, and marks, as we may well believe, the first stage in a progress toward continuous-flow pumping.

Mr. E. D. Leavitt, of Boston, Mass., a well-known engineer who designed the celebrated pumping machinery at the Lynn Water Works, and that of the Calumet and Hecla Mines on Lake Superior, visited the last Paris Exhibition, where pumps were shown constructed on the Riedler system, with the pistons moving at 300 to 400 feet per minute.

The result of this is that the plans for a new pumping plant, designed by Mr. Leavitt for the Boston Water Works, and now being constructed in New York, are on the Riedler system. The pumps are of 20,000,000 gallons daily capacity, operating against a head of 128 feet, or a pressure of 55 pounds per inch, the pistons moving at 200 feet minute, or at twice the usual speed. The water valves are operated positively, and have an area in excess of the pump pistons.

This is, so far as known, the first complete application of the improvements of Professor Riedler in this country, and the result will, no doubt, be the highest efficiency that has been attained, and the capacity of the engine will be double what it would if the pump valves were made to depend on a "reversal" of flow to close them.

Here we have a suggestive example. In a plant costing $150,000 there is a saving of from $40,000 to $50,000 in first cost, and a double capacity for a given weight of machinery, attained mainly by an approach to continuous flow, that is, by not reversing the water to close the valves, with some other refinements.

Mr. Hall, of Plainfield, New Jersey, the inventor of the Hall Duplex Pump, one of the most ingenious and efficient of its kind, is now engaged in experiments that point toward continuous flow in piston pumps. The only information respecting his investigations and experiments known to the writer is found in some recent patents granted to him for such improvements. From these it may be inferred that he has discovered the limitation of reciprocating pumps, and is trying to remove them as Professor Riedler did, but in a different manner, by an uniform working stroke of the pistons, a quick return stroke, and free water ways so the water will move continuously.

Fig. 4 shows a side view of one of Hall's continuous-flow pumps. His method consists in employing two bucket pistons in what is called a **U** barrel, which is simply one barrel in the form of that letter, so the pistons while moving, coincidently in fact, are

moving reversely in respect to the water. There are no valves except in the pistons, which are driven by means of cranks and links so as to produce a nearly uniform forward stroke and a quick return, the pistons acting alternately, so there is no difficulty in maintaining a constant flow at a low velocity, perhaps not exceeding five feet per second. Mr. Hall in his specification says:

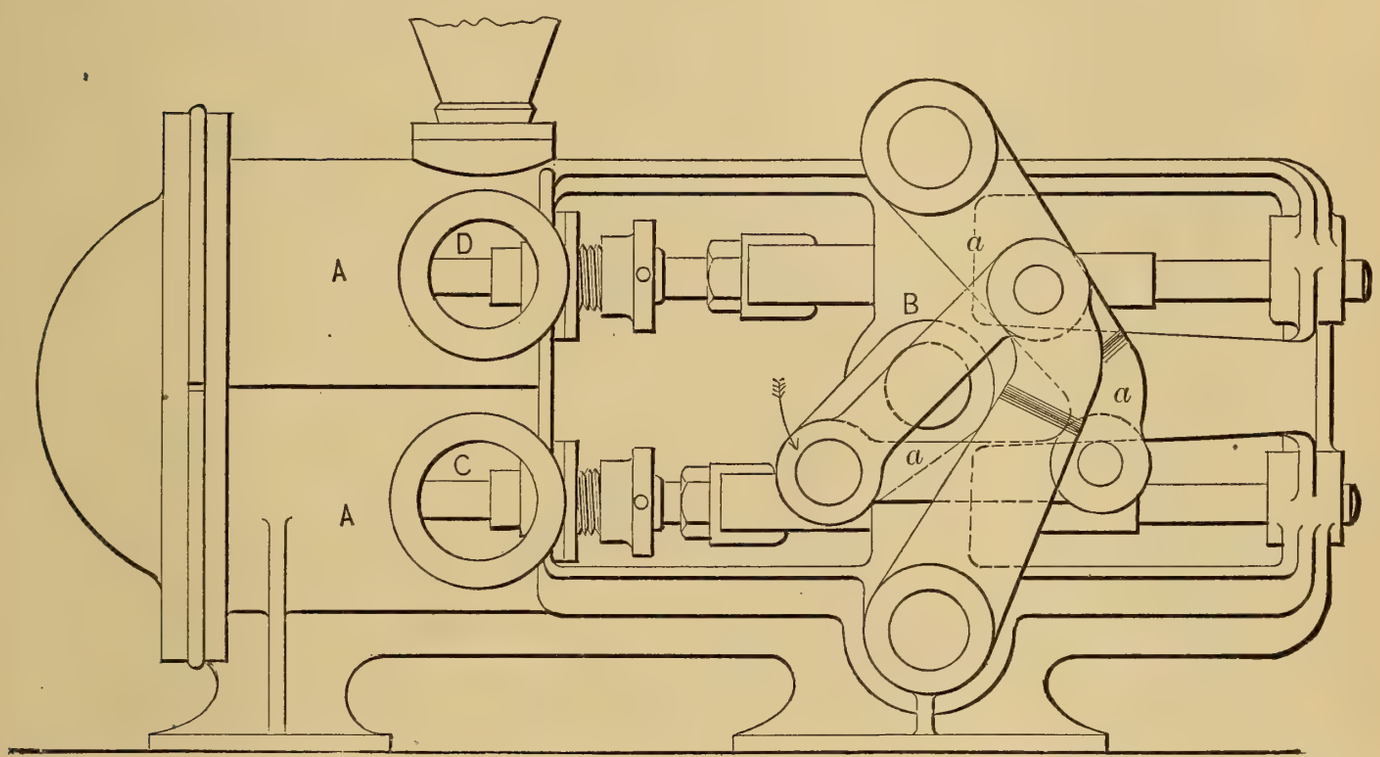


FIG. 4.—HALL'S CONTINUOUS FLOW PUMP.

"Pumps, as ordinarily constructed, impart an intermittent movement to the column of water, the column being first lifted by the thrust of the piston, and coming to rest and remaining seated against the check valve during the return stroke of the piston, so that upon the beginning of the next stroke the column has to be again started against the resistance offered by its inertia."

The writer has had the advantage of conversing many times with Mr. Geo. W. Dickie, an officer of this Society, and also with Mr. W. R. Eckart, also a member, respecting the phenomena that attend on deep pumping in the Comstock Mines with intermittent flow pumps. This experience might be called a "mechanical romance," and if Mr. Dickie could be induced to present some account of it here, it would go to confirm some of the propositions laid down in this paper.

He might also include if he chooses some mention of a pump constructed for him by the author in 1886 that was a puzzle to all

concerned. It was a double-barrel bucket pump with two pistons moving together, and without valves except in the pistons. It was operated by a crank, and a steam engine forming an integral part of the structure, and in performance was, perhaps, the most noisy pump ever produced, and a failure, because of concussive shocks which no one could find any reason for. It will not be creditable to admit that the cause of the pump's peculiar action was discovered five years later by some experiments with a single-acting hand pump.

The explanation is this, the speed of the pump, its methods of construction, and the length of its pipes, made it a continuous flow one, and when the bucket pistons started out on the accelerated portion of their stroke the water was moving at a higher velocity and outran the pistons, but when they overtook the water, the result was much like the action of a steam forging hammer. We had produced a continuous-flow pump and were not aware of it.

Mr. Robert Hall, a maker of pumps in this City, and a member of this Society, makes various pumps that operate by continuous flow, and has not among his patterns and designs any that call for intermittent or arrested flow at the extremes of the stroke. He makes no double-acting pumps that stop and change the flow at each stroke, and very clearly recognizes and understands the principles involved in continuous flow, and applies them accordingly, so far as is possible in his business.

Any single-acting hand pump with a suction pipe of some length becomes a constant flow one, and its valves never close except when the pump stops. The hand movement follows the water or impells it in accordance with the velocity of flow, and the amount of water delivered by such pumps is frequently fifty per cent. or more greater than the theoretical displacement of the piston's range.

Since the foregoing was written the following notes have been appended:

Two well-known engineers in England, Mr. Arthur Rigg, of London, and Mr. D. H. Morton, of Glasgow, have been engaged in a discussion in the *Engineer*, London, over the subject of pump capacity.

Mr. Rigg goes so far as to claim that by attending to all possible improvements the speed of pump pistons, and the water moved by them, can be raised to the same speed attained by centrifugal

pumps. In support of this proposition he presents drawings of a piston pump that has been in use several years, in which the flow or piston speed is about 8 feet per second.

Mr. Morton disputes the possibility of attaining so much, but admits that a great increase of duty is possible. He is a conservative engineer of wide experience in pumping machinery. The following is a quotation from his writings on the subject:

"The high-speed direct-acting pumping engines constructed by M. Farcot for the Paris Waterworks, St. Maur, and elsewhere, in 1871, 1876, and later, seem to fulfill all the requirements which continue to secure successful running at a bucket or piston speed of 350 feet per minute. These pumps have large water chambers, very well formed passages, judiciously placed air cushions, and multiple, or rather sub-subdivided, valves, in design probably very much better for flow than a group of discs. The pumps erected by Messrs. Simpson at the West Middlesex Water Works, Hammersmith, ran on their trials at 290 feet per minute; it is fair, however, to state that in this case the stroke is 8 feet, though speeds of 240 feet per minute are not uncommon with 4 foot stroke in the practice of Messrs. Simpson and others. Engineers who are familiar with the best forms of the horizontal direct-acting air pump are aware that but little modification would be required to convert it into a successful water pump with a piston speed of 300 feet to 400 feet per minute, due care being taken that the water chamber and valve area bear a proper relation to the displacement of the bucket and the speed proposed.

From time to time very pretty and ingenious designs of high-speed pumps have been produced by French, Swiss and Austro-Hungarian engineers. In principle these have generally been of the bucket and plunger, or of the piston and plunger, type, frequently so cleverly disguised as to be beyond casual recognition. Pumps of "unlimited delivery" and of "continuous flow" seem indeed to be very much in the minds of our continental friends, and the sections of many of these pumps, presumably the work of small firms, show an intelligent appreciation of requirements, which is highly creditable to their designers. Some time ago I had an opportunity of seeing tried a small French reciprocating pump whose crank shaft made 250 to 300 revolutions per minute, and although it was not deemed advisable to proceed to make such pumps in this country, the example is interesting as showing what is possible. This type of pump was to be seen at work during the last great exhibition at Paris, the moving parts are simply a bucket and plunger, the foot valve is dispensed with, as once started, the suction column of water has no time to come to rest or fall back."

In a recent notice of a duplex pump, designed by Mr. Thomas Holehouse, at Manchester, England, there appears the following words:

"The pistons are driven at from 300 to 500 feet per minute, at which speed the pumps deliver a continuous stream of water, no pulsation being noticeable, and there is an absence of noise and shock. The valves, waterways and pipes are of large area so as to give as free passage as possible to the water when working at high speed."—*Industries*, April 7th, 1893, No. 354.

In conclusion I am conscious of having occupied your time with a paper of suggestion rather than one of theory or facts, perhaps for reasons that will be sufficiently plain, and, while I am not authorized to say so, it is probable that Prof. D. E. Hughes, a member of this Society, will, at some future time, present here, in a mathematical form, an analysis of these limitations of reciprocating pumps for moving fluids.

THE EXHIBITION BUILDINGS AT CHICAGO.

[See Frontispiece.]

Among the many drawings of the exhibition building that have been published, none have been more complete than the small plate shown as a frontispiece in this issue, for which we are indebted to the *Engineering and Mining Journal*, New York.

The design and construction of these immense buildings is no doubt the most remarkable part of the exhibition. The architecture, in this as in all other cases, comes in for criticism, but architecture is a matter of taste, and as we may say, without a standard.

One marvel is that so much space was secured in the City of Chicago, and reaching, as may be seen, for a considerable distance along the lake shore, thus admitting of a number of features of an aquatic sort that all previous exhibitions of the kind have lacked, and features of much interest and value. The Seine at Paris, and Danube at Vienna, offered some opportunity for small craft, but not much. At Philadelphia and London there was no water for boats.

The display, in many sections at least, will be mainly American. The exhibition itself, in so far as being an international one, is a contradiction of the commercial policy of the country, and hence has not invited exhibits from abroad, except as these appeal to visitors from other countries; still, the spaces have all been filled, though not in all cases by principal firms in the business represented.

ON FURNACE DAMPERS.

"DAMPERS IN STACKS.—Be careful of dampers in stacks; use them with care; be sure they are open before starting the fires. The greatest care should be exercised when light fuel is used, for to close a damper with a large body of fuel on grate bars will cause flame to impinge on bottom over same, thus concentrating heat on one point of boiler. Many good boilers have been bagged and burned from the same cause. Always try and regulate draft by damper in bottom or front."

The above "Essay on Dampers" which is found in an exchange, we propose to shift over under another heading of a "Damper on Essays."

It is an example of the kind of padding one finds nowadays to fill up corners and columns, and will stand the following analysis: In the first place, what is a "stack" that it should need a damper? Evidently a chimney is meant, and we pass this point as one of erratic nomenclature due to the human propensity of using always when possible a slang name for things. "Be careful of dampers in stacks," that is, do not shock or defame them, handle tenderly with care, and grease them to prevent corrosion, also varnish to produce a good effect. "Be sure they are open before starting fires," this is good advice, strengthened by the fact that the fire can not be started with a damper shut, also by the further fact that no one, not a fool, ever thought of starting a fire with a damper shut. The injunction should have included opening the furnace doors before putting fuel into the furnace. The next clause requires more lengthy comment.

"The greatest care should be exercised when light fuel is used, for to close a damper with a large body of fuel on the grate bars will cause flame to impinge on bottom over the same, thus concentrating heat on one point of boiler."

By inserting several definite articles and a substantive or two in the above to complete its intended meaning, it will become as near an untruth as can be imagined. Anyone who has practical experience in burning light fuel, knows that each and all of these statements are precisely opposite to the facts. No one burns light fuel with the damper wide open. The draught may be put on for a short time to ignite a deep bed in the furnace, then the damper should be closed to that point where combustion will meet the requirements of steam generating.

As to the impingement of heat on the boiler, that is nonsense. A wide-open damper might produce that result, but not a smothered

fire, besides, how is the amount of light fuel burned to be regulated if a damper is wide open? The only way we can imagine would be to keep a continuous feeding of the fuel and maintain enough bare grate surface to neutralize the excess of heat.

A skilled fireman who has to burn light fuel such as shavings, dry sawdust, or fibrous offal, in a common furnace, will, by the control of a damper keep the furnace and even boiler flues full of flame by starting and then throttling the draught, he will also save fuel and one half of the labor of firing. Instead of "bagging" a boiler he will keep a nearly uniform heat over the whole heating surface and avoid the impingement referred to.

The last clause says to "Always try and regulate draught by damper in bottom or front." This is a little obscure, but supposing it to mean that the air supply is to be cut off instead of throttling a chimney, we imagine the result would be just the same with the addition of introducing air through all possible leaks and in places where it would not promote combustion.

This is a pretty long comment on a short paragraph, but it will require this much and perhaps a good deal more, to do justice to this kind of instruction by someone who no doubt never put a shovelful of fuel in a furnace in his life.

ARE CALIFORNIA HOMES AS HEALTHFUL AS THEY SHOULD BE?*

By Marsden Manson, C. E.; Ph. D., Mem. Tech. Soc.

This question must be answered in the negative, for the prevalence of filth diseases† in city, village, and country homes in California, in the presence of natural conditions which are a guarantee of the purest health, forces the conclusion that we are not maintaining the healthful conditions which naturally exist. There is, therefore, every justification for a rigid inquiry into the causes which produce and propagate filth diseases, and the use of plain words in laying the facts bare. The threatened visitation of that most frightful of all filth diseases, Asiatic cholera, further accentuates the propriety of bringing up the subject of cleanliness—not only as to person—but

*Read before the Technical Society of the Pacific Coast, May 19, 1893. Reprinted by permission

†The writer prefers the term *filth disease* to the more frequently used term *zymotic disease* The former more plainly expresses the true cause of much sickness, which, when fully appreci ated, suggests the proper remedy — cleanliness.

in the broader and equally important application to water, food, air, and surroundings.

The causes and conditions which propagate many filth diseases have been considered so subtle that an investigation of them is oft-times regarded as super-technical and impracticable until too late, when their track is plainly marked in the health reports and death list. The simple and rigorous methods of analysis which micro-biology brings to the aid of chemistry, makes the detection of the cause and course of filth diseases absolutely certain.

The particular microörganisms which produce certain of these diseases are as well known as are the symptoms; they are traced from patient to patient through the water, food, or clothing with a certainty, which if generally known, would make every intelligent human being an expert in sanitation. They are multiplied in favorable places and under favorable conditions with a degreee of rapidity which would poison a continent in a few weeks with the developments of a single germ. It is therefore necessary to discuss these facts in plain words, and to bring them not only before the physician and the civil engineer, but to the very children in the school house. The complete following up of the study thus inaugurated involves one of the deepest problems of modern science, namely, how to treat small areas so as to permit them to be densely populated without impairing the natural healthfulness, and even to remove natural conditions inimical to healthful occupation.

All the sewers, all the water works, all the heating and ventilating contrivances ever built, have been attempts, more or less successful, to solve this great problem or to remove the fatal consequences of failing to provide proper sanitation at the outset. It therefore becomes necessary for municipal officers to employ the most honest means and the highest talent in planning and constructing every detail of municipal engineering, and to leave no part to the charge of either the ignorant or the grasping. Such large portions of the population of all cities are either ignorant or unmindful of their surroundings that special efforts must be made to force sanitation upon them; not only for themselves, but for the sake of those who are forced to partake of the consequences of witless or vicious self-neglect.

THE CONDITIONS IN THE COUNTRY.

The duties of the writer have called him to many parts of the State, and the natural conditions have been a matter of close obser-

vation and study for many years. It may be said that no filth disease naturally prevails in California, except chills and fever in certain low lands in the great valley, and in similar localities elsewhere. Yet in these localities the disease is easily escaped by avoiding the use of surface water. This fact was first brought to the writer's notice some fifteen years ago by Colonel Mendell of the Engineer Corps, of the U. S. A., and has since been closely followed up and observed in numerous localities.

In travelling through the great valley of California, the close observer is frequently struck with the entire absence of chills and fever in a particular locality of a district over which the disease is generally prevalent, the drainage and surroundings of the escaping locality being frequently worse than the infected neighborhood. The method of ascertaining the conditions is as instructive a way of explaining the facts as any other — After the usual salutations and inquiries as to weather and crops, the subjoined questions and answers follow —

"What kind of water have you?"

"Well water."

"Deep well?"

"No, not very, some twenty feet, struck a fair flow at sixteen feet."

"Is the water good?"

"Firstrate, soft water, washes easy, so the women folks say."

"Any chills and fever?"

"Well, a little now and then towards fall, but we generally go up to the mountains or to the seashore for a time and get over them."

"What causes the chills?"

"Well the air draws in here from the tules and swamps and brings malaria."

Passing on for a mile or less the inquirer reaches a neighbor and asks the same questions of a sturdy citizen whose ruddy youngsters and buxom wife bespeak entire absence from chills. His replies as to water are about as follows —

"Our well is pretty deep, we did'nt get much water at the first gravel and had to bore 190 feet (frequently three or four hundred feet) before we got water, but then got a good flow rising nearly to the surface."

"What kind of water?"

"Firstrate cool water, but a little hard and mineral like. The women folks have to use soda in washing."

"Any chills and fever?"

"No, not here, but down at neighbor Blank's they have a touch in the fall."

"Why do you escape?"

"Well the air draws in here from the plains and we don't get the miasma from the tules."

These questions the writer has asked dozens of times and found that where chills and fever prevail, the wells are either shallow, or the surface water is permitted to drain in alongside the well casing and is pumped up with the deep water.*

In country homes, exposed tanks badly cleaned are another source of injurious contamination. Very frequent cases are found of milch cows and stock being watered from a shallow well surrounded by the accumulated filth and manure of years. The milk or flesh of such animals cannot possibly be wholesome.

The City of Stockton affords a very marked example of the effect of the water supply upon chills and fever. In the earlier history of the city the water was obtained from wells, generally shallow. After the introduction of the water from deep wells, the disease began to disappear, and is now as rare as it was formerly prevalent. A study of the various strata is very instructive in this connection. At from 40 to 60 feet a stratum of dense clay occurs, below which the water is drawn from very distant sources, at from fifteen hundred to twenty six hundred feet the water is hot and charged with light carburetted hydrogen which largely forms the natural gas of the locality.

The disposition of garbage, manure and fæcal matter around country homes rarely receives that attention which health necessitates. The dangerous and fetid cesspool is almost universal. It could be easily replaced by the construction of a closet on a well shedded mound and the use of a little dry earth. With ordinary attention this simple expedient makes the surroundings entirely pure and inodorous. Some such simple method should be obligatory in isolated country school houses and hotels.

THE CONDITIONS IN VILLAGES.

The villages and small towns of California where there is a public water supply, are generally furnished from deep wells supplemented by the wells of individuals. These latter are classified as

*See "Drinking Water as a Source of Malaria," the *Sanitarian*, August, 1892, Vol. XXIX. Page 127.

are country wells, and are subject to greater danger of surface contamination from cesspools and garbage heaps. The mountain towns and villages have generally a water supply of great purity. It is in the villages and small towns that the disposition of fæcal matter reaches its maximum point of danger to health and life. This fact is distinctly recorded in outbreaks of diphtheria, typhoid, and gastric fevers, and other filth diseases—which diseases could find no lodgment were the naturally healthful conditions maintained by the adoption of proper measures.

The most glaring case of contamination of this character which ever came under the writer's notice was as follows: Some five years since, in looking into the sanitary conditions of a valley town, one family in particular was reported as suffering from a series of filth diseases necessitating expensive doctor's and druggist's bills and frequent trips to the seashore. The head of the house had been very positive and strong in his condemnation of the healthfulness of the town, and was then absent and his home tenantless. The case was so aggravated that there was justification for a very thorough examination of the premises. The house-drainage was at first looked to. There were no waterclosets, tubs, nor basins, so that danger from this source did not exist. The kitchen sink, receiving all waste water and refuse matter from this source, drained into an open box very much clogged up and full of putrescent matter. This box passed within a few feet of the well casing and was broken so as to permit the drainage to pass to the well; within less than twenty feet of the well was a cesspool with the putrifying fæcal matter of years soaking through the soil in all directions.

The strong remarks of the owner as to the town were but feeble expressions compared with a proper condemnation of this individual case. Instructions were left to the effect that if pure water were not supplied, the household could dispense with the doctor and druggist and send for the undertaker. It is needless to state that as soon as the causes and actual conditions were pointed out the matter was promptly remedied.

The City of Sacramento is particularly exposed to the pollution of the soil from cesspools. This danger is increased by the drainage of water closets into the cesspool, which practice is essentially more dangerous than the simple pit, although both should be avoided.

An illustration of the results of the want of care as to purity of water supply, is very strikingly illustrated in the case of Plymouth,

Pa. This town has about eight thousand inhabitants. In the spring of 1885, nearly one person in every six was stricken with typhoid fever, more than ten per cent. of the cases being fatal, the deaths being about 130. This outbreak was traced by Doctor Shakespeare to a single case occurring during the winter in the water shed supplying part of the town. The dejecta of this patient were thrown out upon the snow and upon the occurrence of warm weather the germs found their way into the water supply with the above result. The melting of the snow occurred on the 25th of March ; the disease broke out on the 10th of April, and was confined to that portion of the inhabitants using water from the infected source.* Medical and sanitary journals and reports are full of many similar cases.

In the hotels and public schools in the villages and smaller towns without proper sewerage systems the closets are generally of the most primitive kind, and foul to a nauseating degree. The simple measures suggested for country homes would make a marked difference in the health of those exposed to this source of disease. It must be remembered that where improper methods of disposing of human waste are practiced the ill effects are cumulative and are not eradicated in centuries.

Several of the large towns and cities are supplied with river water taken below sources of deadly contamination and only escape its consequences for a time and probably not to the extent that they imagine. In the event of the occurrence of filth diseases of a virulent type above these towns it is difficult to see how they can escape serious visitations of the disease. At this point it is proper to call attention to the illegality of discharging foul matter into the streams of this State and the lax administration of section 374 of the penal code. It will thus be seen that there are too many instances of either ignorance or carelessness as to the water supply of homes, and it is the duty of every house holder to look carefully to this, the most ready course of filth disease into the system.

THE CONDITION IN THE CITY OF SAN FRANCISCO.

The water supply of San Francisco is obtained from several sources, the major portion coming from sources of undoubted excellence. There are two minor sources whose area by reason of growing population and neglect are rapidly becoming dangerous if not already so.

*Page 3, Textbook of Medicine, Strumpell.—Page 4, Practice of Medicine, Oster.

The catchment area of Mountain Lake and Lobos Creek, embracing some 1500 acres, all within the limits of the City and County, is fast gaining in those conditions which pollute both the surface and underground drainage. The most glaring of these conditions are :

1. The absence of any sewer system with proper outlet.
2. The existence within its area of a hospital connecting with a sewer without any outfall.
3. The existence of not overclean "dairies."
4. The use of part of the area for cemetery purposes.
5. The dumping of garbage and filth as filling for lots below grade.

The watershed tributary to Lake Merced, some 5,000 acres in extent, is objectionable from the same general causes, although less in degree and extent.

The area tributary to the present Alameda Creek source will have to be abandoned in the future for the same cause. All areas from which a municipal water supply is drawn should be kept absolutely free from human habitation, and it would be a wise measure for municipalities in a growing country to acquire catchment areas and afforest them. In this way valuable forest reserves could be made for all time, and the area made as valuable for timber as ordinary farming lands, and by the proper selection of the trees to be cut the area made a source of permanent timber supply.

The house tank, when not kept scrupulously clean, is a source of contamination even when pure water is supplied. When not absolutely necessary they should be dispensed with.

Water is the most active disease distributor imaginable, and to paraphrase the very truthful words of a celebrated authority —"No power upon earth could save San Francisco from the scourge of cholera or typhus were a single case to occur or a single infected garment to be washed in one of the watersheds supplying the city with water." The use of a water supply from areas partly within our city limits should be immediately prohibited.

In this connection it may be well to quote from the recent law of the State of New York,* which, in providing for the purity of the water supply of her chief city, conferred upon the Commissioner of Public Works powers possessed only by the most tyrannical governments. Yet these powers were wisely conferred and are being

*An Act to provide for the sanitary protection of the sources of water supply for the City of New York. Approved March 23, 1893.

justly and wisely executed; for never can the power of law be more humanely and justly exercised than in the enforcement of those conditions which prevent the introduction and spread of filth diseases. In this remarkable law the Commissioner of Public Works was authorized to enter in upon the lands and homes of persons breaking the imperative laws of cleanliness, and even to burn up and eradicate every vestige of possible contamination. $1,500,000 is made available in three equal sums for three years.* Such action is necessary in the face of the fact that during the years 1832, 1848, and 1866, cholera had entered that great mart and paralyzed every industry and brought death and sickness in its most frightful and disgusting forms to her homes.

In 1873, cholera devastated the southern and western portions of the United States, but it gained no foothold in New York by reason of the rigid quarantine measures and excellent control of the imported cases.

DISPOSITION OF GARBAGE AND WASTE.

The degree of carelessness and inattention reached in San Francisco to this important sanitary matter is unequaled in any part of the United States. In this City the matter has long passed the stage of official and criminal neglect, and reached that of civic indifference.

Many lots and streets in the northern part of the City have been filled up with highly putrescent matter which cannot be excavated for foundations, sewers, pipes, or conduits of any kind within the next few centuries without endangering human health and life. In the center of the City, and in a district which is surrounded on all sides with dwellings or stores and factories, is an area of many acres already piled from 10 to 20 feet deep with foul and putrifying garbage. During the prevalence of a west wind this pest breeding spot can be smelled a mile or more from shore. With every south wind its pestilential odors are blown through the heart of the City. Its foul smell can be detected not only along the adjacent low-lying districts, but at elevations 300 or more feet above tide water and a

*The New York Academy of Medicine realizing the vast importance of pure water, drafted and presented a bill providing for —

A Croton Water Commission, consisting of five members.

1. The Commissioner of Public Works—President.
2. The Commissioner of Public Health—a Physician.
3. A member of the State Board of Health—a Physician.
4. A member selected by the Chamber of Commerce.
5. A member selected by the American Society of Civil Engineers.

This Board appoints a civil engineer who has power to carry out permanent plans, systems and methods for securing pure water. $50,000 is appropriated for the year 1893, and $20,000 for each year thereafter.

mile and a half away. After a few hours south wind the course of this foul air can readily be traced by dull headaches, and later by influenza and sorethroats if nothing worse.

From 250 to 300 loads are daily added to this pest heap, which in aggregate is more dangerous than a dozen well-conducted hospitals for pestilential diseases. Indeed when the truth is known, vastly more disease can be traced to these sources than to the hospitals; and in fact they are one of the prime causes making the maintenance of pest houses necessary. We have been recently treated to prolonged and bitter discussions as to where a pesthouse should or should not be located, when in our midst conditions are tolerated which are manyfold worse than a pesthouse full of patients, and which may under favorable circumstances make a pest house out of the homes which we have built for ourselves and families, and which repeatedly fill those homes with air too foul to be pleasant and undoubtedly dangerous; and which greatly adds to the danger from the hundreds of local defects in our sewer system. It is not necessary to here anticipate a report now in process of compilation, but it may be safely said that we are running risks which only our unparalleled natural advantages enable us to do with partial impunity. That we do not entirely escape is known to every citizen, for there is not an intelligent being in this City who cannot recall many preventable deaths. Oft' times, alas, of relatives or friends.

These views are the result of years of observation, and are in harmony with centuries of experience. They may not meet the approbation of those whose interests lie in an easy and profitable disposition of this material, nor of those who desire a cheap filling for valuable tide lots. There are interests at stake in every community which are not in harmony with a proper administration of the law. But it is the imperative duty of every man to see that the true needs of the community are subserved. The hope is therefore expressed that the members and our guests will freely express their observations and views, for "in the multitude of counsellors there is safety."

THE U. S. WAR STEAMER MONTEREY.

There seldom happens a more ridiculous case of newspaper blundering than in the reports that have appeared for some months past respecting the war vessel *Monterey*. The *New York Times* discovered that her cylinder boilers were damaged and nearly destroyed. Other mishaps and faults were published, and when the vessel went out on the 28th of May to make a sea run and test her guns, the newspapers eclipsed all former attempts at dealing with technical matters, and discovered that the ship was nearly torn to pieces by the recoil of her guns.

The Navy Department, however, seemed to reach a different conclusion altogether, so much so that the Secretary at Washington thought worth while to telegraph his congratulations on the result of the experiments. To a newspaper reporter, or even to an editor, such matters seemed experiments, and that the purpose was to see if the *Monterey* would stand the shock of her guns, a problem no one could foresee or determine in any other manner. The computations respecting the forces set up and the means of their resistance are profound mysteries to the "newspaper man," and must remain so, because even the greatest journals have never yet risen to the idea of employing skilled men to report upon technical subjects, and the most silly blunders appear respecting all kinds of matters pertaining to machinery, ships, and constructive processes.

The *Monterey's* engines, mounted on her framing, developing thousands of horse power, or still more important, a plunge in the sea, may develop strains that have been tentatively studied, learned and computed by marine architects and engineers. These forces, considering the rhythmic action of one, and indeterminate force of the other, are problems much more difficult to provide against than the reaction of guns.

It is true the employment of heavy ordnance at sea on iron ships has not passed entirely through the experimental stage, and there are strong indications that the limits have been exceeded in the bore and weight of guns, also that there is no compensating advantage to balance the great expense of such guns and provisions to resist their concussion and recoil, but to assume that a vessel constructed at this day is so built as to be injured or disabled by firing her own

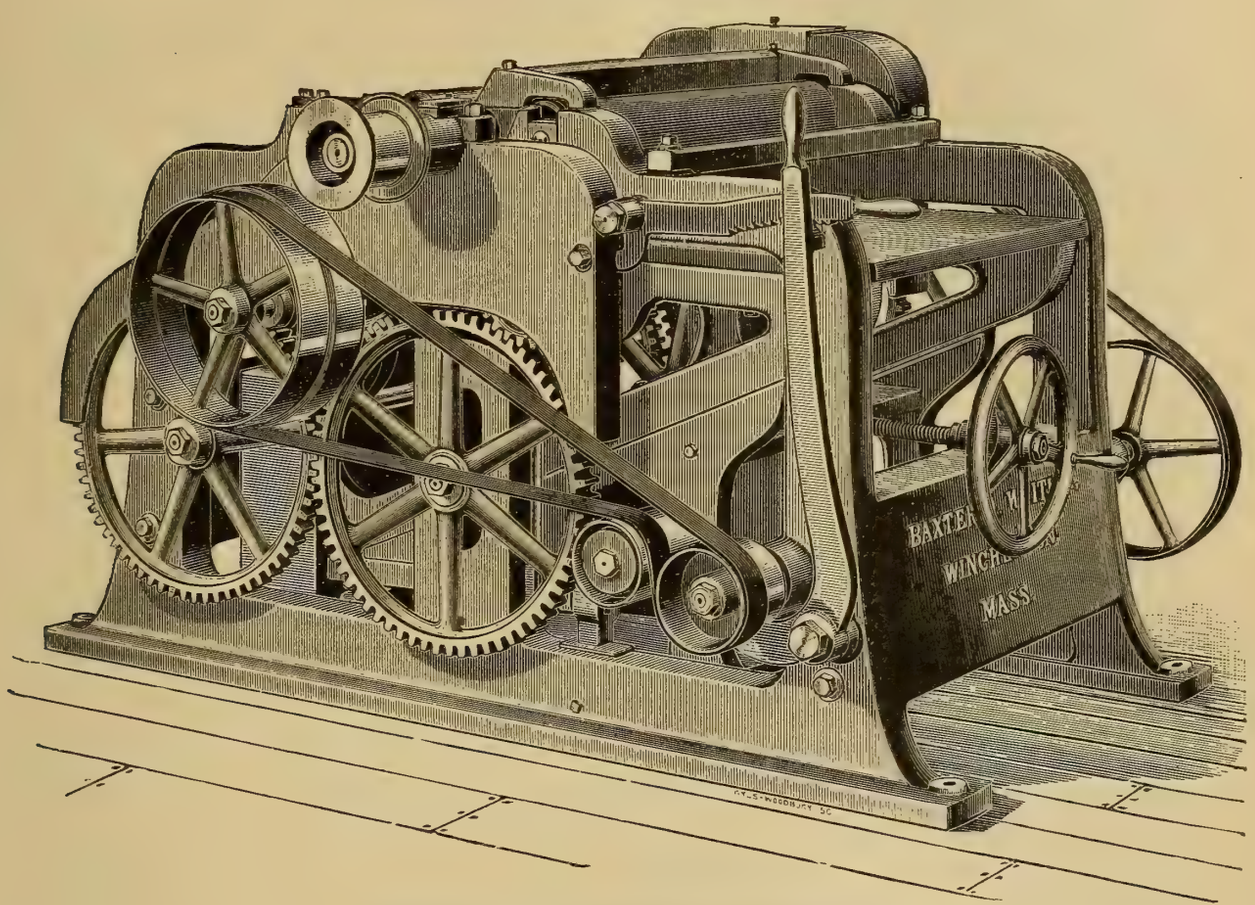
guns, is not only a landsman's idea, but one that ignores modern science.

There will be no modifications worth mentioning that have been suggested by the firing of the *Monterey's* guns, and failures are more likely to come with the ships constructed on the Atlantic Coast than those built by the Union Iron Works. The *San Francisco* is an evidence of this, and is in proud contrast with her Eastern rivals, that have their deck houses and even their rails fitted up of soft pine. The *San Francisco* is finished with teak wood, as are all good vessels of our time, and years of service will not show the shabby wear that occurs in a month or two with woodwork of soft pine.

The *Tokio* and *Pekin* are examples of this soft pine finish. We were on them while building, nearly twenty years ago, and saw for the first time, hatch combings of pine wood. The circumstance was never forgotten, and a report of it was questioned by the editors of *Engineering*, who could not believe that deck work of any kind could be made of such an inferior material and then grained in imitation of walnut, when hard woods of great variety were obtainable at reasonable prices.

These things we mention because the reports first named are construed as reflecting upon the contractors who built the *Monterey* and other war vessels here. When these ships fail there will be disaster for the rest.

The new American Navy consists of forty two vessels, as follows: One sea-going battleship (first class): the Iowa. Three coast-line battleships (first class): the Massachusetts, Indiana, and Oregon. Two battleships (second class): the Main, and Texas. Six double turreted harbor-defense vessels: the Puritan, Monterey, Miantonomoh, Monadonock, Terror, and Amphitrite. Two armored cruisers: the New York and Brooklyn. One ram, the Katahdin. Two protected cruisers of extreme speed: the Columbia and Minneapolis. Fourteen cruisers: the Olympia, Baltimore, Chicago, Philadelphia, San Francisco, Newark, Charleston, Boston, Atlanta, Cincinnati, Raleigh, Detroit, Montgomery and Marblehead. One dispatch vessel: the Dolphin. Six gunboats: the Yorktown, Concord, Bennington, Machias, Castine and Petrel. One dynamite vessel: the Vesuvius. One practice vessel: the Bancroft. Two torpedo boats and the Cushing and No. 2.



WOOD-PLANING MACHINE.

B. D. WHITNEY, WINCHENDON, MASS.

A Notice of his Works.

The machine shown in the plate above corresponds to one made by Mr. Whitney for the U. S. Patent Office, which we expect to illustrate in a future number.. He has also sent us some examples of work done by it that are marvelous, and seemingly impossible; for example, pieces of hard walnut planed down from ½ in. to $\frac{5}{1000}$ in. thick, and drawn out of the machine before completion to show the "concave" of the cut against the grain, which is nearly as smooth as the flat surfaces, and these are almost polished.

In connection with this circumstance we propose, as a matter of interest to our readers, to give some account of the remarkable business carried on in the Winchendon works.

Mr. Whitney, while he calls himself a maker of wood-working machines, cannot be included among makers of regular machines of that class. He does not make but few that enter into the general trade, so it will be no disparagement of other makers to say

that no where else in the world has such accurate workmanship been bestowed on wood-cutting machines.

Twenty-five years ago, Mr. Whitney began looking into the world outside of his quiet village, and proceeded to test the merits of some of his peculiar products by sending to the first exhibition in Paris, some very perfect machines for planing and scraping wood. The last named machines, all things being considered, are among the most remarkable ever made, calling for fitting and adjustments so accurate and peculiar, that although the patents have lapsed a dozen years ago, no one in Europe or America, so far as we know, has ever attempted to produce similar machines. They cut off, at the rate of 30 feet a minute, a thin shaving like a web of paper, from the surface of boards up to 40 inches wide, regardless of knots or burls, leaving the surfaces ready for varnishing; so smooth, indeed, that sand-papering is an injury.

These machines treat the hardest woods, including teak, and one of them will perform in what is called "cleaning off," the work of a hundred men, and in a manner impossible to equal by hand.

There are not less than thirty sets of these machines in use in Great Britain, and perhaps twice this number in Europe altogether.

The planing machine and others shown at Paris in 1868 were of such workmanship and performance, that the jury of awards spent much time in inspecting this remarkable exhibit from a New England village, and awarded a gold medal in recognition of its merits.

At Vienna, in Austria, the same thing was repeated in 1873, when several new specialties were added.

Two circumstances will illustrate the standard of workmanship in Mr. Whitney's works. More than twenty-five years ago he had made by Sir Joseph Whitworth & Co., in England, a master screw three inches in diameter, about thirty feet long, from which he could generate screws of accurate pitch for his machines and tools.

In 1875, when the American Standard Gauge Works were projected, Mr. Whitney was entrusted with the construction of the machines required in this accurate manufacture, and made thirteen different machines, nearly all of which are now in use at the works of the Gauge Company — James A. Taylor & Co., Wilmington, Delaware. These machines were of surprising accuracy.

Mr. Whitney has for more than twenty years past been engaged in building a shop of granite, at Winchendon. The openings to the ground floor are flanked with huge square columns of granite the whole length of the story. The wheel pits, dam, and all founda-

tions are of granite, ashler work laid in cement, and will be there for ages after the builder has turned over to posterity one of the most fitting monuments that his genius could contrive. He will also leave a lesson and example of what the efforts of one man can produce, and the width to which his influence may extend in improving and elevating skilled industry.

THE GREAT SIBERIAN RAILWAY.

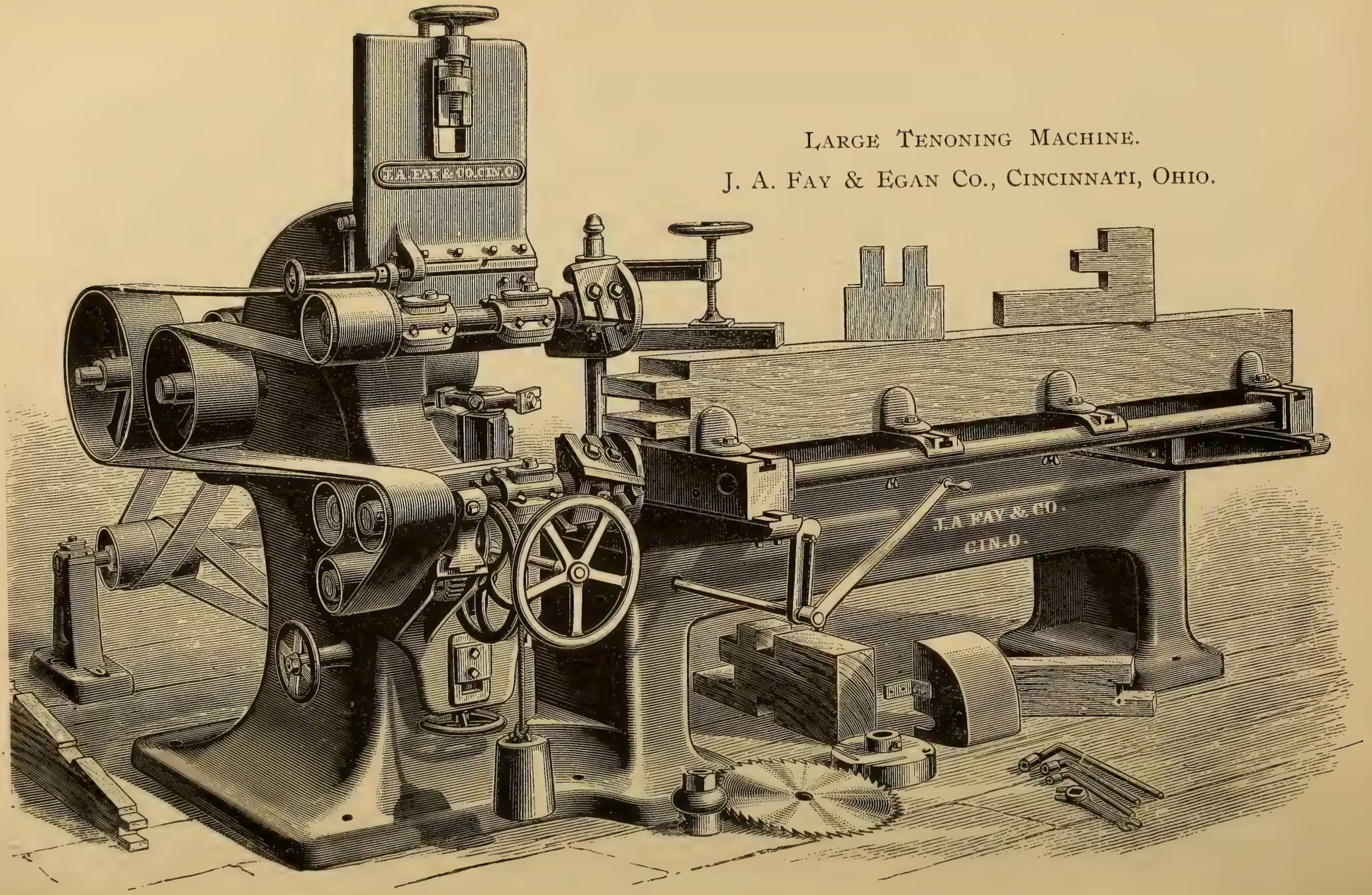
Among the interesting papers of the past month a foremost place must be given to that of Mr. Frederick Hobart, on the trans-Siberian Railway of Russia, in the *Engineering Magazine*.

The article is written with much clearness and completeness, mainly from the facts and quantities furnished in official reports, and is the first comprehensive essay and history of this wonderful scheme that has appeared. The whole length of the main line is 4,700 miles, and with branches, 5,000 miles. The estimated cost of the work is $200,000,000. The plans contemplate the completion of the line to Irkoutsk in six years, and the entire line in eleven years hence, or in 1904. Mr. Hobart says it is tolerably certain that Valdivostok will not be the Pacific terminus, because of this port being too far north, and the want of proper harbor facilities. He thinks some port in Korea more likely to be chosen.

The Siberian Railway is military and political — not commercial, an artery of the empire running north and east, reaching from the center to the periphery, and acting as the trans-Caspian line has done, to consolidate the interests of this vast and mysterious empire.

Some computations we have seen, set down the possible commercial business of the line as capable of maintaining it, less a deficit of $16,000,000 or so, and if this is true, there is little doubt of its being completed and becoming a permanent addition to Russia's power in the North.

Whether the line will become a route of travel for the general public is doubtful, not only because of the physical conditions of the country traversed, but the policy of the Russian Government, which may not permit such travel through the dominions traversed. The engineers seem to be all Russians, and no doubt their ability for such work surpasses what could be drawn from other countries.



LARGE TENONING MACHINE.

J. A. FAY & EGAN CO., CINCINNATI, OHIO.

LARGE TENONING MACHINE.

THE J. A. FAY & EGAN CO., CINCINNATI, OHIO.

The engraving on the opposite page illustrates what is no doubt the largest tenoning machine that has been made to this time. The drawing is so complete that nearly every detail can be seen, except the power-feeding devices for the carriage, which are operated by the crank lever seen in front. The makers send the following description of the machines :

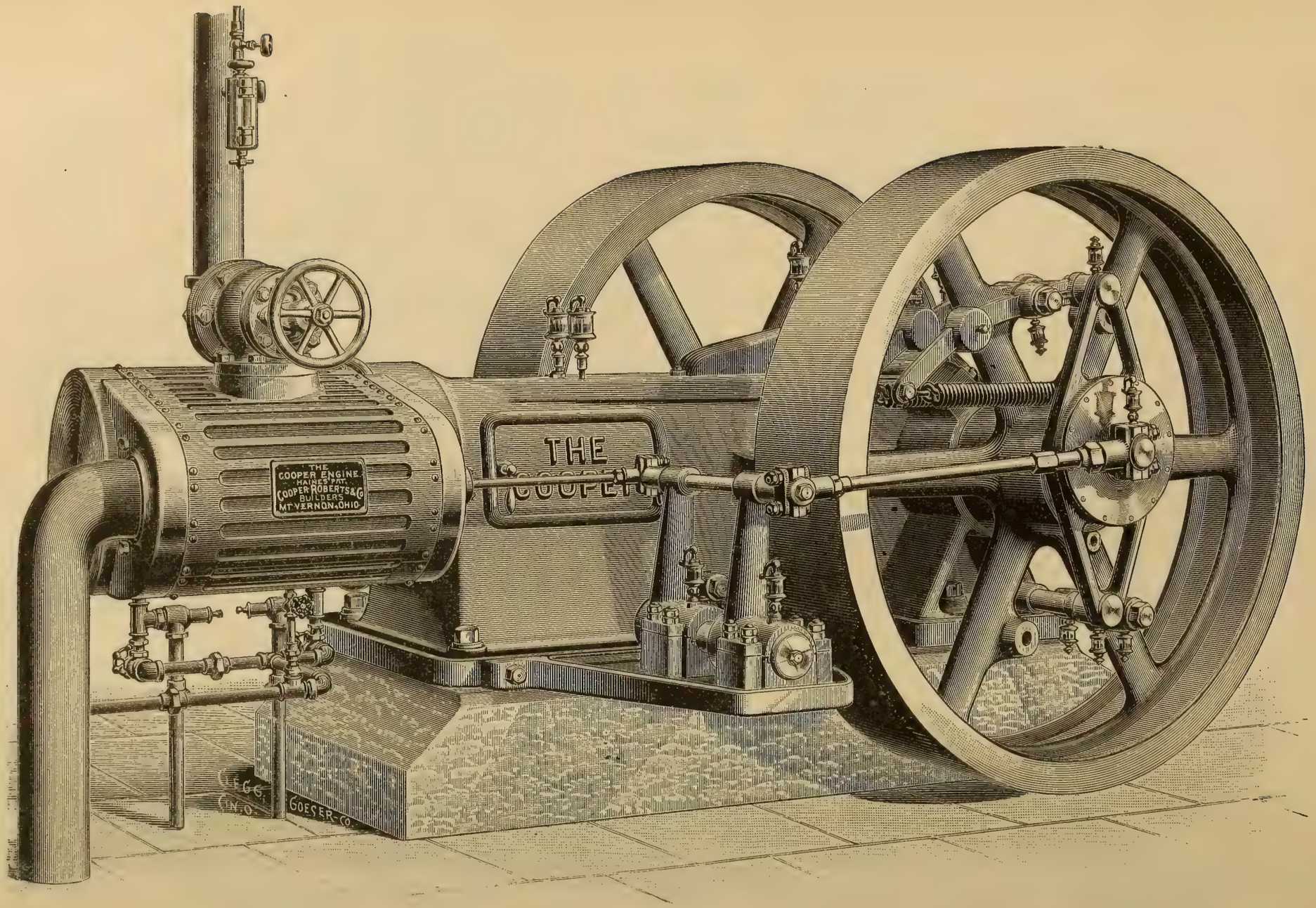
"This machine is designed for making all kinds of tenons on heavy timbers required in car and bridge building, either single or double, also for cutting gains on heavy pieces, and for cutting off purposes. It is the most powerful machine for the purpose ever constructed, and can be relied upon for the performance of any work of the kind, the design is peculiar in respect to the gap or throat across the column for the passage of timbers between the cutter heads. The column is massive and heavy, and cast in one piece, as is also the sole plate or bed, upon which the carriage works.

These machines will perform a variety of work, such as making single or double tenons, and with the application of a gaining head upon the top spindle, will do all kinds of over-gaining, or by placing a gaining head on the lower spindle, will do all kinds of under-gaining on the ends, or by extending through the gap of the machine will operate on any portion of a stick of timber that may be required.

By the removal of the lower cutter head and the substitution of a circular saw, the machine is adapted for all purposes of heavy cutting-off. The head, mounted upon a vertical spindle, in bearings gibbed on the inner side of the column in the rear of the tenoning heads, is for producing double tenons. This head is adjustable up or down, and is arranged to cut to a line or point coincident with the cutter plane of the lower tenoning head.

The tenoning heads are mounted on heavy steel shafts, $1\frac{11}{16}''$ diameter, provided with large self-lubricating bearings, which are cast to a cross slide that is gibbed to the face of the column above and below the gap. The knives will cut tenons six inches long at one operation, or by repassing the material, any length of tenons desired can be made. Both main cutter heads have a vertical motion, simultaneous or independent, while the upper cutter has an additional end adjustment for making one tenon longer than the other. The cutter heads are belted by a novel system which secures an open gap for the passage of long timber.

The carriage is self-operating, driven by a screw and friction gearing. On heavy timber and long work, the power feed will be found desirable. On short work it can be disengaged and the carriage operated by hand. The countershaft is placed in the rear of the machine."



High-Speed Steam Engine.—Cooper, Roberts & Co., Mount Vernon, Ohio.

HIGH-SPEED STEAM ENGINES.

COOPER, ROBERTS & CO., MOUNT VERNON, OHIO.

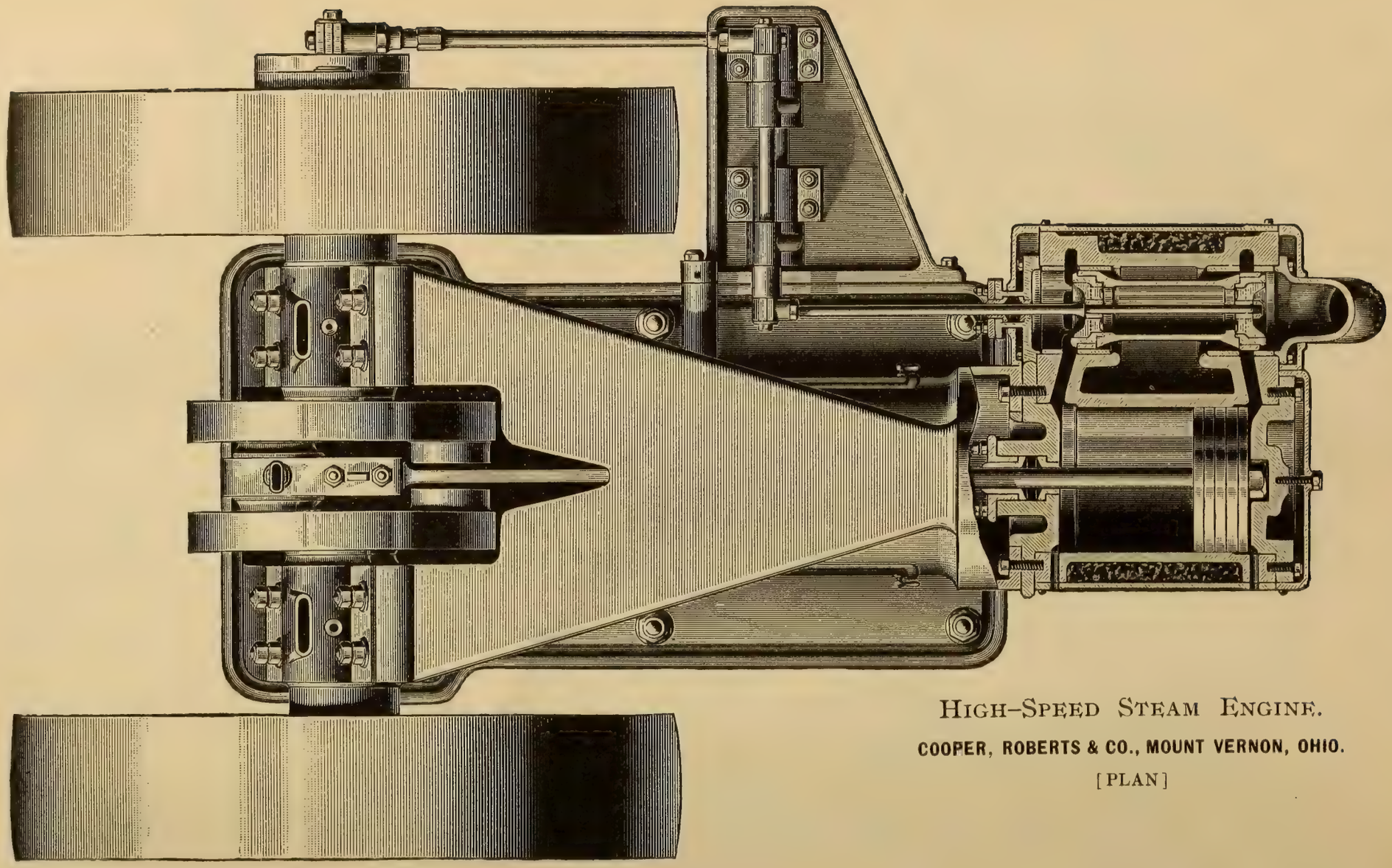
We have, during five years past, made it a point to publish at intervals, examples showing the progress of American high-speed engine practice, mainly as a matter of technical interest, but also because of the development of a type of engines peculiar to this country. This work has for a decade past gone on regularly as a case of "industrial evolution." The sequence of such change and progress are not apparent, perhaps, to those not called upon to watch such things, but exists nevertheless. The various component parts or elements taken individually, as well as the engines taken as a whole furnish equal evidence of "evolution," and so sweeping have these changes been that "revolution" will not be a strained term to apply.

On the opposite and next page are shown in elevation and plan, one of the latest designs in high-speed practice, by Messrs. Cooper, Roberts & Co. of Mount Vernon, Ohio, an old and well-known firm that by reason of modern tendency have been compelled to add to their designs and manufacture an excellent class of high-speed engines.

So familiar have people become with the various features of such engines, that the construction is understood from good drawings, such as are furnished in the present case, and description is required only of material and such points as cannot be illustrated. Among these latter is the manner of mounting the eccentric by means of compensating links that produce a movement straight across the center of the shaft, so that admission and cut off remain the same for the stroke each way and does not vary for each end, as when the eccentric swings in the arc of a circle. The nature of this movement will be understood from the side views or elevation on the opposite page. It is simple and effective.

The bearings, or the "brasses," as our English friends would say, are of phosphor bronze throughout. The principal points that will attract attention are the massiveness of all the parts and the disposition of the metal in the frame, which is in the lines of strain as nearly as possible, and "straight." Simple engines of the class are made from 20 to 330 horse power, and compounded, from 60 to 400 horse power.

In connection with the subject of these engines we are reminded of an article of some months ago in a foreign journal under the head



HIGH-SPEED STEAM ENGINE.

COOPER, ROBERTS & CO., MOUNT VERNON, OHIO.

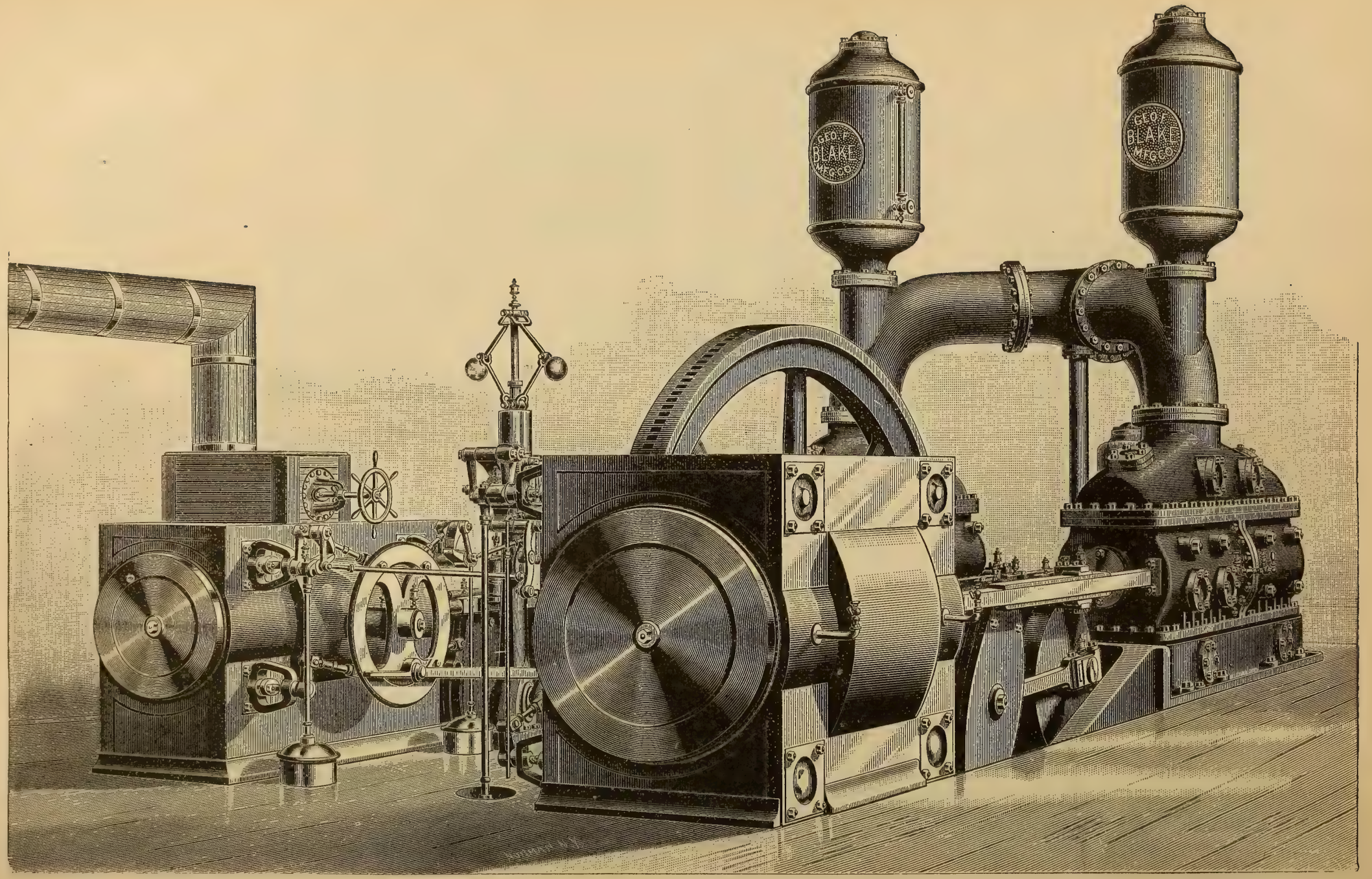
[PLAN]

of "Fashion in Steam Engines," in which the American high-speed designs were contrasted with those of Europe, and the difference set down to what the writer called "fashion." It seemed so to him, no doubt, but a better analysis will show in these American high-speed engines, one of the most careful adaptations to purpose that can be found in the whole field of modern machine practice.

This admission we make with as much prejudice against high speed as modern circumstances will permit, but with full recognition of the fact that the speed, like all else that concerns steam engines, is a problem of "compensation," that is, one engine may have a piston speed of 400 feet and another 800 feet per minute, yet both engines be working under the normal conditions provided for in their construction.

The principal impediment met with in the race for high speed has been the endurance of bearings and provisions to maintain uniform contact over the surfaces, and unfailing lubrication. To attain uniform contact of bearings, deflection must be avoided, and this calls for a center crank, straight lines to resist strains, and the best material for bearing surfaces ; the latter to include not only external but internal surfaces.

Messrs. Cooper, Roberts & Co. have chosen a piston valve of very simple construction, made hollow, so the released steam is taken out through the interior of the valve and escapes at the end as seen in the plan view, where the cylinder and valve are shown in section. This conducts the exhaust steam directly away from the cylinder. This is quite an important matter, considering the temperature attained when there is an almost constant flow of steam at 350 degrees or more. The design of these engines will bear close study.



High-Duty Pumping Engine.—The Geo. F. Blake M'f'g Co., New York.

HIGH-DUTY PUMPING ENGINE.

THE GEO. F. BLAKE MANUFACTURING CO., NEW YORK.

Messrs. H. P. Gregory & Co., the agents in this City, send the opposite plate with the particulars of a late test made with one of these engines at Newton, Mass.

The tables representing the results have been carefully and elaborately worked out, and have been widely published, but will bear some further notice in connection with the construction of the engine itself.

The duty guaranteed, was 115,000,000 foot pounds in water lifted, with 1,100 pounds of water evaporated from 212 degrees of temperature. This was exceeded by more than nine per cent.

The high pressure cylinder is 21 inches diameter, the low pressure one 42 inches, and the pump pistons 13.5 inches with a stroke of 40 inches. The engine, as will be seen, is not a rotative one in the common sense of that term, the rotary elements being employed only to regulate the range of stroke and to operate the regulating and valve gearing. The latter is of the oscillating or Corliss type, the induction valves being variably released and closed by dash pots in the usual manner of Corliss engines.

The speed of the pistons during the trials named, was 130.3 feet per minute, which is perhaps an easy limit with a stroke of 40 inches. The boilers evaporated 12.08 pounds of water per pound of Cumberland coal, one pound less than the stipulated duty, and the performance as a whole is one of a very remarkable character. The absolute steam pressure averaged 140.32 pounds per inch, and the two cylinders were so proportioned as to very fairly divide the work, the horse power being 114.03 for the initial cylinder, and 136.24 for the second one, the aggregate being 250.27 horse power.

It is a matter of surprise to consider the weight and cost of a pumping engine of this class at this day, compared with former practice. Dividing duty into weight will show a difference of at least 50 per cent., if the comparison is made with the Cornish type of pumping engines. There is no waste of material. The operating strains upon the cylinders are taken up by direct struts, fall on continuous piston rods, and are absorbed within the machine and by members that have this and also other functions.

The history of permanent pumps in this country for ten years past will show a tolerably regular tendency toward the type here

shown, caused by the economic reasons just mentioned, and with continual gain of duty, it is a very creditable branch of constructive engineering in this country, that has commanded much attention all over the world, and one that has, except in piston speed, reached, no doubt, a culminating point, in so far as engines and pumps. Combustion and steam generating will be the objective points in further advances, or at least these seem to be behind pumps and engines in the race.

Messrs. H. P. Gregory & Co. inform us that several pumping engines, similar to the one shown, are employed in the Hawaiian Islands for raising water for irrigation, and that complete reports of working tests are supplied on application.

THE U. S. DEBRIS COMMISSION.

The Debris Commission, now being organized, or in other words the engineer officers of the Government being assigned to this new duty as a special commission, are now ready to receive petitions from those who desire to operate hydraulic mines under the late Act of Congress relating to that subject.

Maps and plans must be sent in when required, also statistics of various kinds, attested and correct, showing the position, drainage and topography of mines. We imagine Colonel Geo. H. Mendell, Major Benyaurd and Major Huer of the engineer corps, are not enthusiastic over these new honors thrust upon them, and also that their appointment is as little relished by the hydraulic miners. It is not what they wanted, at least not what the large mines wanted. It is a kind of court they are not accustomed to, and one that will be found as inflexible as it is impartial and able.

There will be nothing to hinder the issuance of licenses and the resumption of work in any mine when there is no infraction of the rights of other people, or so long as hydraulic mining is carried on under the same rules and conditions that pertain to other business, and this is precisely what the statute provided for before the enactment of special laws. The principal gain will be in bringing to bear upon private interests the professional skill of the commission in determining methods of avoiding injury to other people, but there will no doubt be much difference of opinion respecting the nature and efficiency of impounding dams and other restraining works to be made.

This concession, whatever its importance, is all that the General Government can be expected to confer in the interests of a private industry. There is no more reason for impounding the debris of a mine than in building levees to protect private lands, or building dams to furnish water power for private factories or the irrigation of privately owned lands. The distinction is clear. Whatever the citizens of the United States can use in common, such as the navigable streams, harbors, lights and so on, should be maintained by the General Government, or in other words, by a national tax, and any measure controverting this obvious rule cannot be permanent or good.

The want of prompt procedure under the general law of damages at the beginning threw this whole matter into a chaotic form and roused an opposition to hydraulic mining that was captious no doubt and extreme. The facts were of a nature too technical for popular understanding, and as is always the case, suspicion and reprisal were the result. The special laws, debris commissions, and endless expense and loss of ten years past, is a result of not adhering to old and well proved laws regulating the common rights of citizens, a penalty for loose procedure, and the present commission is only a reversion to principles that should have been adhered to and enforced at the start. This view is the only safe one, and expectation of more will result in disappointment. Whatever succeeds must be adjusted to the great law of equal personal rights that forms or should form the basis of all legislation affecting industrial rights and relations.

SOME WANTING EXHIBITS.

We were much astonished, and still more disappointed, to learn that except for a single machine or working model of a machine exhibited by the Government, Mr. B. D. Whitney, of Winchendon, Mass., will not exhibit any of his machines at Chicago. The extent of this loss will be better understood after reading some account of his works given in another place in this issue.

The special machines made by Mr. Whitney would have been a unique and creditable exhibit, without anything of their class to compete with, unless it would be in planing wood, and his machines for that purpose are special. Mr. Whitney could not secure the required space to set his machines. The same thing occurred in the case of Professor John E. Sweet, of the Straight Line Engine Com-

pany, of Syracuse, New York. This company's engines would have reflected much credit on American high speed practice, a type by themselves of proved excellence and notable novelty.

In a letter from Professor Sweet some months ago he complained of the facilities offered for showing his engines, and stated that he would take no part in the exhibition. Still more remarkable is the absence of the two chief machine tool making firms in this country, Messrs. William Sellers & Co., and Messrs. Bement Miles & Co., both of Philadelphia. These firms stand at the head of their business, in a branch that will no doubt, be closely contested by foreign exhibitors at Chicago. These works are easily the first in the land, known all over the world, and will be inquired after first by those from abroad interested in this advanced branch of skilled industry.

EXHIBITION NOTES.

Mr. F. J. Miller, associate editor of the *American Machinist*, is at Chicago, and seems to be observing things there in a very careful manner. When he has occasion to speak of a spade he employs the plain name of that implement, and amuses his readers by an account of an exhibitor in the mechanical section, who, after sundry formal proceedings and $85.00 in money, had a wash bowl set up in his space. When this proceeding was completed he was informed that its use was an infraction of a "concession" to some one at the other end of tbe building who kept a lavatory and charged a fee. The wash bowl was removed. Insurance policies are at a rate of fourteen per cent. per annum, and power for exhibiting purposes $60.00 for the term. Of restaurants, Mr. Miller says :

"In one corner of the Machinery Hall there is a space fenced off, within which are counters made of boards not fit for pattern lumber, roughly constructed, and with rude and uncomfortable stools in front of them. Here you can get things to eat and drink by paying the prices of a first-class restaurant, which this is not, as is perhaps best indicated by the fact that there is no bill of fare, and you use your coat sleeve or anything else you may choose for a napkin. No other eating facilities are provided within Machinery Hall."

The dual management by the Goverment and local boards, which has from the beginning been an impediment, with the persistant position of the railways in exacting nearly full fare, and other causes, has reduced the attendance far below the estimate, and now the financial stringency prevailing throughout the country is added to other difficulties that will, to some extent, hinder visitors from going to Chicago.

VELASCO HARBORS.

The following description of the method of constructing the jetties at the mouth of the Brazos River, in Texas, is taken from an article in the *Velasco World*, by Mr. Walfred W. Wilson, of Austin, Texas.

"There are being built at the mouth of the Brazos River, on the gulf coast of Texas, two massive jetties, the object of which is to scour out and maintain a depth of 20 feet of water over the bar. This work is being carried on by a private corporation at a cost of $850,000, and is now almost finished. The jetties are 5,400 feet in length and 560 feet apart. They start from the shore line, and extend out to and end upon the outer slope or over the bar. The mode of construction is as follows: Wharves are first built at the shore end of the jetties. Brush mattresses are then placed between the piles of these wharves and loaded with stone, so as to form substantial headings from which to build the jetties seaward. The mattress work is constructed from a trestle of four rows of piling for each jetty. The mattress strips are made continuous by splicing, and the lower mattresses are supported by timbers suspended from the trestles. Brush is first piled crosswise, then lengthwise, and then crosswise again, sufficient that when compressed the mattress is from two to three feet thick and 250 feet in length. The strips are placed five feet apart, and are connected by galvanized wire rope. A compression strain of one ton is given the binders at each connection. The upper strips of the lower mattress are used for the lower strips of the upper mattress, and so on until sufficient thickness is obtained, that when firmly forced on the gulf bottom the top of the jetty will be about two feet above the flow of the average flood tide. The jetty is then loaded with stone and concrete to thoroughly consolidate it. The interstices of the brush work are filled with sufficient rock to give the jetty a weight of 75 pounds per cubic foot displacement.

The jetties are parallel to each other, so that the forces at command are applied uniformly throughout the whole length of the channel. The axis of the jetties are at right angles to the deep-water curves in the gulf, and the end of the east jetty extends beyond the end of the west jetty, thus protecting it and the channel entrance from heavy seas and drifting sands. The work is carried on by means of a double railroad track extending seaward as the jetties progress, and the brush mattresses are hauled upon tilting ways, placed upon a platform car, while the piles are driven by an overhanging driver. The mattresses are launched between the piles, and loaded with sufficient stone to hold them in place. A platform is arranged under the tilting ways, on which the necessary amount of stone is carried, and from which it is thrown on the mattress as

soon as it is afloat and made fast to the piles. When the sea will permit, foundation mattresses are floated ahead, anchored in position."

The following extract is from another article in the same issue of the *World:*

"The Brazos River was formed by waters flowing from its source in the Panhandle, Texas, several thousand feet above sea level. The bays along the Gulf of Mexico were formed by the shifting sands in shallow water near its border, forming peninsulas and islands in front of a portion of its waters, which were then called bays, and the same action of these waters are gradually filling up the passways into these bays, and the sand bars formed at their entrance cannot be removed by narrowing the channel, as the same water that passes into the bar passes out again with the same velocity, only shifting the sand from place to place. Nor does the Trinity River, which flows into Galveston Bay, affect it any, the bay containing 120 square miles of water. Therefore there is absolutely no means by which a continued rapid current could be produced from a bay into a gulf except by extending and narrowing some natural stream by artificial means."

We reprint these extracts with pleasure, because the first one indicates a cheap and, at the same time, complete method of construction in such cases, and the second one points to a truth respecting scour, which is almost too obvious for argument, namely: the current must remain continually in one direction, or at least there must be no reflux.

The works at Galveston, which include estimates for future works of five or six millions, are not made under these conditions. The flow is both ways, and no permanent scour can be expected. The energetic people who have expended their money at Velasco, without broaching the National Treasury, deserve the success, that is within measurable distance if accounts of the works are correct.

The power of the trans-Mississippi railways will, no doubt, soon be brought to bear against this deep-water harbor on the Gulf of Mexico. It is a menace to their business, but this southwestern country is filling up with men not to be trifled with, as the Topeka and later conventions have shown.

The Southern Pacific Company, with the north and south lines west of the Missouri, that may become allies or feeders to their system, is the only trans-continental line prepared for a Gulf port. This Company have foreseen and provided for such an outlet for the Southwest.

THE TECHNICAL SOCIETY.

This Society met on June 2nd at their rooms, 819 Market Street. The main business of the evening was the discussion of some problems in pumping fluids. Mr. Richards presenting a communication on the subject, which is printed elsewhere in this issue.

One proposition for membership was received, and Mr. Geo. F. Low of this City, electrical engineer, was elected a member of the Society.

At the next regular meeting, Friday, July 7th, Mr. N. J. Manson will deliver an address entitled: "Inter-Oceanic Ship Canal Communication by the American Isthmus. Its Geographic and Economic Relation towards the United States." The subject will be open for discussion upon any topic connected therewith. Mr. W. A. Doble will contribute a communication on the "Use of Coal Oil in Steam Boilers."

ELECTRICITY.

NOTES.

Electric welding of metals is making slow but steady progress, fast enough, perhaps, if blunders and losses are not to be made. A new plant is being erected in Pittsburgh, Pa., to be employed in making various kinds of sheet iron vessels such as are commonly riveted, the seams being welded instead. The Johnstown machines for welding railway bars and other rolled sections has proved a success when pitted against the best fire processes. It has required a good deal of courage to venture upon expensive machinery and appliances for this purpose in the face of such uncertainty as has attended electrical applications primarily, that is, uncertainty as to how long the processes would last without improvement and modification. Welding has, however, from the first held its place as a fact, the economy of the method being the main point in question when there was not a large number of uniform forces to be joined.

People have long waited, and with much hope for improvements in the construction and endurance of electric storage batteries. The economic importance of storage is such that it is never lost sight of

on the part of the public, but the interest of the electric companies is not so marked, because storage means economy in consumption, and cuts out the margin between the maximum amount of current contracted for and the actual amount used. This margin, as in the case of water, affords commonly a fair profit on investment. It is exceedingly difficult, among the confusion of reports that are afloat, to see what the real progress of storage is. There is no doubt of the successful use of the accumulator system in Paris, where the Tramway Company have supplanted their horses by this method of traction, and if it succeeds there, why not elsewhere? The Exhibition boats at Chicago driven by storage batteries will be an extensive experiment in this country, out of which should come some valuable knowledge and improvements.

One difficulty met with in the use of electric motors is in their regulation as to speed, it is a strange circumstance, as well as a very creditable one, that in this feature the Electrical Engineering Company of this City have made greater advances than the great firms and companies in the East and abroad. It is true the company here have confined their attention mainly to motors and for purposes where close regulation has been essential, while the larger companies have confined their principal efforts to other and more extensive branches. The motors of the Electrical Engineering Company are governed by a compounded force of centrifugal weights, and the resistance of the transmitting gearing. These two forces acting conjointly, or either of them independently, so that either an increase of speed or a decrease of resistance acts upon the brushes to diminish the power, or decrease of speed and increase of resistance augments the current, the result being an almost perfect regulation. The mechanism of the governors, which are placed on the armature shaft, is of a very perfect kind.

At the last annual meeting of the American Institute of Electrical Engineers, Dr. Frederick A. C. Perrine offered a suggestion respecting the establishment of a branch or connected organization of the Institute on this Coast, at San Francisco. This led to a tolerably wide discussion of a matter that has engaged the attention of other technical organizations, and one that is surrounded with much difficulty, however many useful results could be attained. The theory of segregation is bad, unless it be in a case like this Coast presents, so far removed that attendance and the use of society

properties and facilities is impossible. San Francisco is farther from New York than London is, and it costs as much time and more money to travel from one city to the other, so the case is peculiar. Still, the impediments to branch societies are not much modified by this fact. The discussion named will appear before long in the Transactions of the Institute, and can be read with profit.

The slowness with which electric motors are applied to machine tools indicates either some difficulty not apparent, or else a very tardy application in design. In a few cases motors have been "built in," so to call it, so as to constitute an integral part of the machines in a manner that would be naturally expected, but the rule seems to be when this means of power transmission is employed, to mount a motor on the floor or wall somewhere in the vicinity of the machine and then connect by bands. In other cases the motors are put on brackets or ledges attached to the machine framing, but not in a manner that is symmetrical or to appear as though electrical driving was a part of the original plan. An exception is where the armatures have been put directly on lathe or other spindles, and on some punching machines. A good arrangement for motors would be to enclose them in trunk frames, but so as to be drawn out, or put them on top above other working parts and gear them with wheels instead of belts.

In some recent discussions in the Technical Society of this City, there appeared the usual emulation, to give it a mild name, between the mechanical engineers and electricians, and we suggest that whatever of this exists is due mainly to electrical terminology. It is common to speak of electric power, driving machines with electricity, and often contrasting electric motors with steam engines and water wheels, just as though one was a substitute for the other. Whatever electricity may do in the future, just now it is not a power or means of driving anything, but is a medium of transmission, the same as bands, gear wheels, ropes, water, or air. That it is a good means of transmission no one can doubt, and it has functions of great convenience and value as such, but it is not a motive power; that term belongs to first movers or implements that utilize natural energy directly. It is true, power can be derived from direct combustion or consumption of zinc in batteries, but not at a cost that permits commercial use at this time.

The General Electric Company is fast increasing the capacity of their generators and will soon rank with, if not exceed, their European competitors. At the beginning of 1892 the company had not made any generating machines of more than 300 horse power, but now have to their account, seven machines of 2,000 horse power that have been made or contracted for. Locomotives of 1,600 horse power have been made, and the chances are that in the near future the constructive department will have to be divided and classified. The heavier work can not well be done on tools and with appliances suitable for the smaller work, which must always remain in the greater part. The capital of the company is $40,000,000, and the earnings last year were reported at three and a half millions, so the business is quite large enough to permit subdivision without loss in the way of expenses for separate manufacturing departments.

A NEW ELECTRICAL DISCOVERY.

Consul General Frank H. Mason, of Frankfort, Germany, communicates to the State Department under date of March 31st last, an account of a remarkable method of electric heating. The following quotation is from the Consul General's report:

"The apparatus consists of a glass or porcelain vase, which may be of any size conveniently adapted to the purpose, provided with a lining of lead connected with a strong conductor of positive electricity. The vase is filled to three-fourths its capacity with acidified water. A pair of iron tongs with insulated handles is attached by a flexible conductor to the negative pole of an electrical current generated by an ordinary dynamo. With this simple and inexpensive equipment the following phenomenon is produced.

The electric current having been switched on, a bar of wrought iron or other metal is taken up with the tongs and plunged into the water within the vase. Immediately the water begins to boil at the point of contact; the immersed portion of the iron rises quickly to a red, then to a white heat, and emits a stream of brilliant white light. In a few moments the heat becomes so intense that the iron melts and falls off in bubbles and sparks, leaving a clear glowing surface in perfect condition for welding. The heating process has been so rapid that neither the water nor the end of the bar held within the tongs has been more than slightly warmed, and, the current being switched off, the bar, with its submerged end glowing, may be readily held in the naked hand. If, instead of a bar of metal, a stick of carbon is used, the heat in a few minutes produces detached fragments of amphorous carbon, which proves scientifically that 4,000° Celsius has been developed. The rapidity of

heating and the limit of temperature to be reached are easily and accurately governed by the strength of the current employed, so the whole process is under the absolute control of the operator.

During the recent experiments at Berlin the measuring instruments registered a tension of 120 volts and an energy of 220 amperes. It was estimated that fully 50 per cent. of the current was directly utilized as heat, whereas the practical limit of such utility has not hitherto exceeded 20 per cent. It is stated by the inventors that by employing a still stronger current a temperature of 8,000° Celsius has been developed. The mechanical importance of this fact will be apparent when it is remembered that this is a degree of heat nearly three times greater than that required to extract iron from the ores, the most refractory of which fuse at aboul 2,700°. * * * * * * * *

The current passing through the tongs and metallic bar into the water, decomposes the latter into its two gaseous elements—oxygen and hydrogen. The oxygen is attracted and gathered on the relatively large surface of the lead lining and produces no noticeable effect. The hydrogen, on the other hand, gathers around the immersed portion of the bar; and as this has a comparatively limited surface area, it is immediately surrounded with a close envelope or jacket of hydrogen, which, being a bad conductor of electricity, creates a powerful resistance to the passage of the current and thus develops the heat which causes the bar to glow and melt. It is merely an application of the well-known law that friction or resistance to the passage of an electric current causes heat, and the apparent paradox of a pice of cold metal plunged into cold water rising rapidly to a melting glow is as simply and clearly explained as the incandescence of a platinum coil in a vacuum bulb.''

MINING.

NOTES.

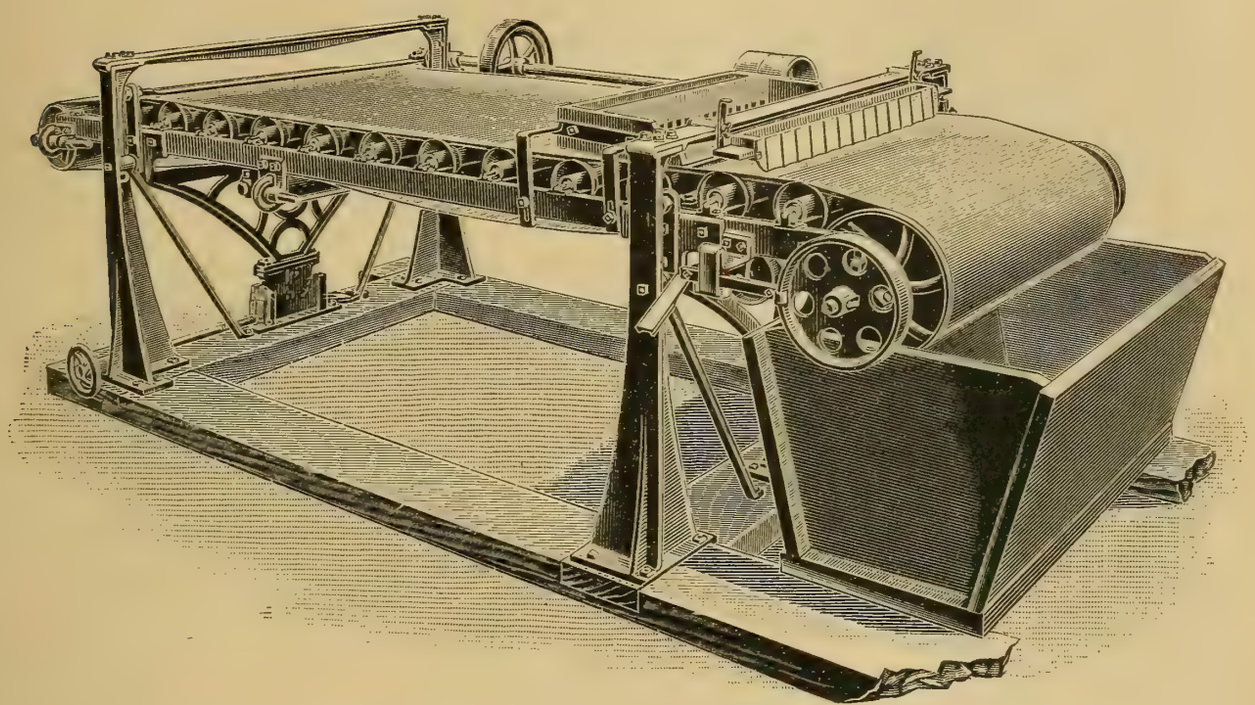
The sale of the Idaho mine, at Grass Valley, to the Maryland Company is quite an event in mining matters, and gives to this City the advantage of the future residence here of the owners, Messrs. Coleman Bros., who, for a score of years, have owned and operated this celebrated property. The Idaho is perhaps the most noted of all California gold mines, at least has been the most stable, paying regularly fair earnings on the investment, and never the subject of speculative share trading. The Maryland mine is an adjoining property on the same load, and the two have had some conflicting interests that will now be joined. The Idaho mine and mill are to be worked at full capacity, which will be happy news for the people there and at Grass Valley.

There has been invented in Australia a new gold-saving machine, which, from accounts that reach us through the *Australian Mining Standard*, is novel and effective. It is based upon separation or selection by centrifugal force, and operates like a cream separator, except that the action is reversed, that is, the saved or valuable portion is precipitated, and not floated as in a cream separator. The main object is to separate fine free gold from tailings, and if the rapidity of treatment, or its cost, which is the same thing, is low enough the matter should be looked into by miners here. Information can be procured by addressing Mr. G. C. Horstman, at Brisbane, Australia, who is the chairman of a company formed there to exploit the invention. As a general remark we think that centrifugal force has been too much neglected as an agent in separation of various kinds. We now depend on gravity, which is too weak a force to act on fine gold or any finely-divided substance.

An attempt is to be made to work placer mines on the Colorado River with water pumped 200 feet high, which seems a great impediment, but if the water is "kept up" after being raised, falling only enough to perform its office in washing, the expense of raising it may not be so great as would seem. The works are forty miles above Yuma, where wood is the only fuel that can be procured. The pumping plant will consist of economical pumps made by the Worthington Company, in three sections, aggregating 500 horse power. The water is conveyed five miles through pipes, which will cause a considerable loss by friction. The quantity is estimated at 205 miners inches. The company is called the California Picacho Gold-Gravel Mining Company, with headquarters at Los Angeles.

There seems just now to be quite a development of mining interests in Amador County, Cal. People best acquainted with the matter claim that the difference between present methods of mining and those of twelve years ago are sufficient to permit successful working of nearly all the closed mines on the mother lode, and there is certainly a good deal to warrant such an opinion. The Wildman mine at Sutter Creek, is a fair example. This mine was shut down for a number of years, and then re-opened with modern machinery for hoisting, pumping, crushing, concentrating, and nearly all facilities for treating the sulphurets. The result is a valuable property. The Zeile, Plymouth, Consolidated, and Kennedy mines, with others, furnish examples of how methods must be changed from the old

speculative and wasteful ways to more careful and stable management, with better machinery and various economies that cannot be enumerated.



NEW TULLOCK CONCENTRATOR.

DEMAREST & FULLEN, ANGELS, CAL.

The engraving above shows in perspective elevation a new modification and improvement of the Tullock Concentrator, on which the inventor, Mr. James Tullock, of Angels, Cal., has secured four different patents.

These machines are very well known among mining men, and certainly have the claim of great simplicity, as the drawings will show. The inventor of the machines sends the following notes and explanations respecting the machines as they are now made and the principle upon which they operate.

"No concentrating device can be more simple. The belt which conveys power to the machine drives one shaft with two eccentrics attached. There are no cone pulleys, sprocket wheels, or tooth gearing. The driving belt rocks the machine and this motion does all the rest.

The concentrating belt receives a side-rocking motion—the true cradle or rocker motion so well known to our early placer miners. The forward travel of the belt on its frame is not a continuous movement, but is made up of a series of sudden jerks, coming regularly and without fail. A combination not attained by any other machine of the kind. The mechanism which produces the forward travel of the concentrator belt, being entirely independent of the

driving belt, makes possible an instant adjustment of feed, or its instant removal.

The "grade" of the machine can readily be altered by means of a hand wheel while the concentrator is in motion. In erecting the machine there is no extra expense for foundation frames. The machinery just as it comes from the works is ready to set on any good floor. By reason of its duplicate construction, all wearing parts of this machine can be replaced with little expense. Steel shafting is used throughout. The rocker shoes and dies are made of the best white iron. The sliding parts of the feed device are hardened steel.

The machine is now being made with jigs and templates so that parts of any machine are interchangeable with those of another, and duplicates ordered by number for the various parts of the machine will fit. The belts furnished with these concentrators are commonly of duck covered with a coating of rubber paint. India rubber belts are provided when ordered, but the canvas belts operated by this machine will catch all the amalgam and quicksilver escaping from the batteries. The total weight of iron and steel entering into each machine is about 1,400 pounds. Price of concentrator complete, boxed and delivered on board cars at Milton, Cal., is $350.00."

MEXICAN ORES.

There was, among all impartial people who had any knowledge of the mineral industry in this country, a tolerably uniform opinion that the extra duties assessed on Mexican lead and silver ores three years ago was a blunder, or what was worse, an attempt to benefit a few people to the loss and disadvantage of a much greater number. This view has been confirmed by the circumstances since then, and it is no surprise to find Consul General Sutton, of Nuevo Laredo, writing to the Department of State, at Washington, as follows:

"Owing to tariff legislation in the United States in 1889 and 1890, which shut out low-grade Mexican ores formerly exported in large quantities for reduction in the United States, a large smelting industry has been built up in Mexico. In 1889 this export traffic had just fairly begun, and had immense possibilities. Our smelters at Kansas City, in Colorado, and other places, were taking large quantities of fluxing ores at such rates as made their mining profitable in Mexico, and gave a large traffic from the mines out of Mexico, and through a portion of our territory. It was traffic sorely needed by the railways so recently built through a country largely undeveloped. This one item of freight might easily have amounted to $2,000,000 per annum. The traffic would at the same time have developed the mining industries of Mexico, and given a general impetus to all other industries. More than this, it would have retained for the United States the capital in these smelters, and given

employment in our territory to large numbers of laborers in the reduction of these ores, as well as in their handling en route.

Besides the low-grade fluxing ores there was then, and still is, a considerable and growing export from Mexico to the United States of high-grade, or dry, ores. The legislation of which I speak imposed duties on the lead contents of these fluxing ores, provided they were classed as silver ores, and in case they were classed as lead ores imposed a duty on the whole bulk. The result has been greatly to reduce this traffic, confining it to only such quantities as were absolutely needed.

There was, however, another result. American capital left the United States, and came to Mexico to establish in this country smelters to do here the work which had previously been done in the United States. Three smelters have been erected at Monterey, one at San Luis Potosi, perhaps the largest and most complete of its kind in the world, besides several other plants in different portions of Mexico. The cost of these plants, and the money directly invested in ores and in handling the business, may be safely stated in round numbers at $10,000,000 in United States coin. Not only has our country lost this much capital by investment abroad, and Mexico gained that much, but with this money have come many prominent and enterprising citizens, and large numbers of employés. They have built up Monterey, San Luis Potosi, and other towns. The railways in Mexico, which had formerly carried low-grade ores to the United States, getting a long haul, are now obliged to haul these ores shorter distances to the Mexican smelter. As Monterey is a large mining center the mileage on ores to the smelters located there is comparatively short, and the earnings of the railways much reduced in consequence. To be sure they have the carriage of the silver-lead bullion after smelting, but that is a minor affair compared with the hauling of the original raw material.

Within sight of my office is a concentrating plant, in Laredo, Texas, costing perhaps $250,000, which was finished just before this law went into operation. It has never been used. Had the duty not been imposed the crude ores could have been brought from the near-by Mexican mines, concentrated there, and the concentrates carried forward to Kansas City and other points for smelting. The same thing occurred at El Paso, Texas, in about the same degree, and for the same reasons. At that time there were many other enterprises of a similar sort in contemplation, and, but for the imposition of the duty on this lead ore, there would have been from $2,000,000 to $3,000,000 worth of such plants on our side of the border ere this.

Of course there are compensations to the railways for this loss of carrying low-grade ores. They now bring larger quantities of coke and coal than before, but not nearly enough to compensate. The result has been that Mexico has gained from $10,000,000 to $15,000,000 of American capital, as well as hundreds of our energetic and enterprising citizens, who are rapidly building up and developing her territory."

COMMENTS.

The premiums for speed of war ships, the *Marine Review* intimates is a little overdone, pointing out that four vessels have gained in this way $453,042, or nearly half a million for their builders. Considering the uncertain circumstances of such tests, and that the speeds attained have little to do with future performance, there is a good deal of unreason in the method and no gain of any permanent value. The average speeds of British war vessels, it has been claimed, is not two thirds of their trial rate, and this when no premium was given. As the kind or quantity of fuel is not stipulated, a premium for a forced rate looks inconsistent, as does the requirement for a contract rate, when the plans for the ships are laid down by the government. It might at first have been necessary in order to induce bids, but is no longer required, and should be abandoned as the *Review* suggests.

The decline in what are called industrial stocks, during the month of May, was about $70,000,000, and this, strange to say, produced no great disturbance in the financial world, and at the time had indeed, but little effect upon confidence in investments. One reason of this is no doubt in the element called "water" in these stocks, that is, an inflated nominal value to diffuse and excuse earnings. If a person has shares of the kind, one half of which are "water," a shrinkage to that extent is borne with equanimity, because the real value, the one paid for, remains intact and nothing is lost to holders who do not speculate. The fact is, the fluctuations of stocks, as is only too well known in California, relate to the gambling phase of the matter and have no real or permanent effect upon the actual worth of industrial shares when rated at their true value.

The battle in the British Parliament over the Irish Home Rule Bill waxes strong, and nearly all views of it, in that and in this country, have their origin in prejudice. The logical facts and inferences as seen by Mr. Gladstone himself, and others who can divest themselves of prejudice, present a feasible and honest treatment of a problem that has never had any treatment at all that has succeeded in the past. Those who assert the impracticability of Irish

government, should go to the Isle of Man and see how they manage there. Here is a parallel with a people of nearly analogous race, governed in name by England, but really governing themselves in a manner that other countries around them would fain attain. Aside from religious bigotry no one can show why the larger island can not be governed the same as the smaller one, but for this one impediment, and that impediment must in any case be got rid of.

The *Railway Age*, speaking of the Canadian Pacific Railway, says that 7,000 miles of line are operated. The earnings of 1892 were $21,409,352, and expenses $12,989,004, making net earnings $8,420,348. Out of this a dividend of five per cent. was paid and $6,923,531 was carried to a surplus fund, of which $4,000,000 has been placed to insure five per cent. dividends for two years to come. If this is correct, and the authority is scarcely to be questioned, this Canadian Railway constitutes a menace to the trans-continental lines in this country, not only in a "physical" sense, but in the more important one of commercial management. The building up of the only line that is really a trans-continental one, and founding a steamer communication to Australia, India, China, and Japan, in about eight years' time is a portentious feat in such enterprises, that no doubt has its chief management elsewhere than in the Dominion.

At this day when the labor question is the one of all others, and when a large section of the best technical, trade, and serial literature is devoted to this matter, no one seems to remember that the character of these contests has much changed in late years, and changed for the better. In England, where trade unions are strongest, such disputes now commonly result in "arbitration," scarcely heard of only a few years ago. The proceedings are more rational and fair, but it must be remembered that in order to arbitrate such disputes the profits of employers must be disclosed, and to this there is generally no objection in England, where prices are more stable than here and business less speculative. On the whole there is an improvement on former methods, and there is little use in railing at industrial organization. It is a fact of the time, among employers and employed, and indeed in all branches of human interests and professions down to physicians and lawyers. It is the old "guilds" under a new name and prevention is impossible.

Professor James Bryce, a member of Parliament in England (we do not employ professors in this manner here) in a recent address before the Institute of Civil Engineers, London, pointed out that in imaginative fiction no one has ever chosen an engineer to be the villain of a romance. This is certainly true, and means a good deal. Priests are sometimes pilloried in this manner, but engineers, never. This is not accident altogether. There is a cause for it. An engineer deals with truths as nearly as human intellect can determine thereon. His works are proved by computation, and his work rests on the immutable laws of mathematics and observed results. Villiany is untruth, sometimes faith or the result of faith, or credulity. It is always hypocritical because deceit is the foundation of it. This may be but one out of many causes, but the fact remains that there is no direct affinity between villainy and applied science. Rogues find more promising business than technical work.

It will be news to most people that the British trans-Atlantic vessels are using Virginia coal, and that the *Campania* on her first home run was driven with Pocahontas coal. The Cunard and White Star lines now supply themselves at New York with Virginia coal that contains 86.5 per cent. carbon. The coal is carried by railway to Norfolk, Virginia, and thence by water to New York, where it is supplied to steam vessels of all kinds. The output of Pocahontas coal, it is reported, has reached the enormous amount of 3,000,000 tons a year. Formerly British steamers carried out Cardiff coal for the return voyage, and thereby much diminished their capacity for outward freight. This supply at New York is a very important fact in the trade, also a great commercial gain to this country. At the Pocahontas, Virginia mines, some of the veins are nine feet in thickness, level, and the cost of mining is a minimum.

The causes of financial disturbance at this time are invented and discovered with such frequency that a new one does not command much attention, still there is all the time some progress towards a better understanding. Perhaps the main reason of all is the withdrawal of foreign investment in this country due to a distrust caused by the vagaries of the silver problem, or of its discussion. One may estimate the probable effect of such a thing by imagining themselves the owners of shares or securities in some foreign country where an agitation of the kind was going on, and where a large share of the citizens were clamoring for a law that would add about 33 per cent.

to the value of the coin in use. All investments called in are so much gold removed, not figuratively but actually, and the drain will go on so long as agitation exists. Obscure or secondary results do not come within the province of popular understanding, or any understanding, certainly not of those who are not engaged in framing laws to govern the matter.

Among other canal schemes of the day, one originating in St. Paul, Minn., proposes a canal from there to Duluth at the head of Lake Superior. This seems, among all the recent interland canal schemes, to be the best. There are no mountains or physical obstacles of any kind and plenty of water to maintain a level above the lake and river wherever required. The distance is long, 200 miles or more, but the traffic would be great, and to a large extent furnished by local business, such as carrying wheat to the Lake and bringing back coal. From a map view one would think a lower point on the Lake would be better, but the grain-handling appliances at Duluth would compel a terminus there. A company has been organized in St. Paul, to construct the canal, the cost of which is estimated at $20,000,000.

A correspondent contributed to a late number of the *Star*, in this City, some account of John Cleves Symmes, the "hollow world man" as he is called in Ohio where he lived. Symmes was a man of considerable scientific attainments and a brother-in-law of General Harrison, elected President of the United States in 1840, and grandfather of our last President, Benjamin Harrison. The old homestead of the Harrisons' is at North Bend, sixteen miles below Cincinnati near the mouth of the Great Miami River. The tomb of General Harrison is there, so also is that of John Cleves Symmes, the latter marked by a marble pedestal on the top of which is a hollow globe emblematic of his belief of a hollow world. It is a romantic spot, and near one of the most noted works of the "Mound Builders," which called out from General Harrison a paper read before the Cincinnati Historical Society about 1838, that we have been trying to procure a copy of for many years past. General Harrison, like his friend John Cleves Symmes, was fond of pursuing speculative studies, and was a man with endowments not suspected at this day. His paper on the age of the ancient works in the Miami Valley is extraordinary in its conclnsions and written in a style that cannot be surpassed.

Engineering Notes.

What is called the Winby locomotive, exhibited at Chicago, is a very marked departure from common practice. There are four cylinders, two inside and two outside the frame, 16½ and 17 inches in diameter respectively, with 22 and 24 inch stroke. The boiler is of an elongated, or oval section vertically, with a set of stays through the horizontal center transversely. There are 2,000 square feet of heating surface, and the total weight of the engine is 144,400 pounds. The main object is high speed and power combined. This makes up a very novel locomotive, and it is trusted the engine will, as reported, steam back to New York from Chicago so its performance can be seen. Wide departures in locomotive practice commonly fail, and this one seems wide enough to come within that category, but the design is by experienced men, and is not produced as a mere novelty but with a view to special service.

Mr. John Walker, of Cleveland, Ohio, manager of the Walker Manufacturing Company there, has constructed a wheel-cutting machine that performs double duty by having two cutters operate at the same time at different points, or opposite sides of the wheels to be cut. It is singular that this has not been done before, because there is not only the gain of a double duty but an equilibrium of strains on the wheel, that is quite an object to attain. The machine is of a simple and symmetrical construction for spur wheels, and the purpose has, no doubt, been to facilitate the construction of cut wheels, of which his company prepare a great many of large size. Our readers will remember one we illustrated last year, made for the Kimberly Mines in South Africa, that was more than 30 feet in diameter and weighed 62 tons. The Company now make a good many engine-cut steel wheels of large size.

From an account given of starting the engines that drive the electric generators at Chicago there was not much care given to preparing and erecting the machinery. The Buckeye Engine Company alone, it seems, started their triple compound engine, and went on without a hitch of any kind. They started their engine of 1,500 horse power at 3:30 P. M., on June 6th, and ran fifteen hours at full power, stopped two hours, and then started for another heat of

fifteen hours. It requires care and skill to so make and erect an engine of this size and type, so steam can be turned on, and a run of fifteen hours made without a hitch of some kind. The engine above named drives a large dynamo for lighting purposes. The Buckeye Engine Company have had similar experiences before, when their engines alone, among a number, were the only ones that were started and not stopped. At the New Orleans exhibition for example.

Mr. Arthur Rigg, of London, has recently designed for the City of Margate a system of sewage pumps that are driven by water pressure at 700 pounds per inch, generated at a station for that purpose. This is by no means the only case where water at high pressure is employed as a means of transmitting power to sludge or sewage pumps, and there are a good many advantages in the system. The amount of work to be done varies greatly, and the pumps have to be automatic in starting when there is an accumulation, and stop when their work is done, all of which is more easily managed with hydraulic apparatus than by steam or air. The distributing valves for the power engines are somewhat complicated, but everything else is extremely simple. The pump valves, which are the point of most interest, are not described in the *Engineer*, which publishes a description of the Margate plant.

If the present method of providing duplicates of machinery for American war vessels turns out as it does in other cases the result will be a disappointment. There are a few things of course that should have "spares," but when it comes to duplicating pumps and nearly all the auxiliary details of a war vessel it is going too far, especially with a vessel like the *Monterey*, having shallow draught and low decks, so that when done she is much like a watch case filled up with machinery. This, however, is not the main argument against duplicate parts. They are too commonly provided for in the character of the parts duplicated, and the spare parts are often in worse condition than those in use. If one half the cost of the extra pumps, valves, shafts, or other details, was expended in making the other ones so they "would not fail" that would be more in the line of true precaution against accident. The best rules in this matter are derivable from the merchant service, as are all rules pertaining to ocean navigation, exigencies there being provided for in the highest degree that present knowledge permits.

The *Woodworker* says the German firm of Ernest Kirschner & Co., of Leipsig, exhibit sixty-five wood-working machines at Chicago, and they intend to establish an agency in this country. The firm employ 700 men, and have made 26,000 machines for working wood, including 160 bandsawing machines for large timber. We do not see very well, how an agency here would do any good, except for planing machines, and we trust enough of these may be sent here to teach our people the methods followed in Germany and elsewhere. Our machines are certainly wrong end foremost, or wrong side up, and it is time they were otherwise arranged, especially if we expect to sell them in other countries. As to other operation in wood, Messrs. Kirschner & Co. will find the processes here so different that their machines will not answer very well. Wood-working has become a "manufacture" in this country. In Germany it is not so, except in a few cases.

A late "fad" in machine-tool arrangement is a set of separate bands on the step pulleys of engine lathes, drawn up by idle pulleys and levers, giving the lathe the appearance of a section of picket fence. The countershaft cone pulley is placed in a box standard beneath the head-stock, and the rest of the shaft is extended out beyond the lathe on the floor, in a manner that would not be tolerated in any well-regulated shop. It will be a happiness when inventors will let the common lathe head-stock alone. It is one of the most perfect examples of mechanism that exists, and does not need improving except in workmanship. The only thing done for twenty years past, worthy the name of improvement, has been the introduction of an extra or third set of back gear wheels, and even this, with a number of advantages, is a questionable innovation for a standard lathe. A blacksmith's anvil seems to be the only implement that escapes improvers.

There is little doubt that as the principal railways in this country perfect their road beds and running conditions the speed of trains will excel what is attained in other countries. During the past month there has been some remarkable tests of the speed of trains for short distances, reported as reaching a rate of 112 miles an hour, but this does not mean much, and is of no interest to the travelling public. It is the schedule time of moving trains that shows the speed of the traffic, and to include the runs out of New York in various directions the rate has risen to an average, not excelled unless it

be by trains out of London. We, some time ago, collected a number of time tables, and divided the distance columns by the hours in the time columns, and in respect to long runs across the continent, and in traffic west of the Rocky Mountains, the result showed about 20 miles an hour, or something less than the present rate of high-class steamers. The speed of trains bears a very constant relation to competition between lines.

Attempts to adapt the machinery of war vessels to cruising and emergency speeds have not been very successful, and in the nature of things cannot be. The boilers can be subdivided, and are at control, but the engines are not, and without change for the slower speed, must work at a great disadvantage in respect to economy. A good share of the auxiliary machinery must also be kept going when cruising at reduced speeds, and as these engines must be run at full speed, as in the case of dynamo, hydraulic and ventilating engines, this becomes also a loss of power for want of adaptation, unless there are two independent plants or sets of engines. It is proposed in some of the late war steamers to disconnect the low-pressure cylinders, which are of little or no use at slow speed, and may become a resistance by the steam pressure falling below the vacuum. The chief of the Bureau of Steam Engineering has not a happy or easy position to fill these times.

Last year we announced the appointment of a commission to conduct experiments determining the holding power of cut and wire nails, and promised to publish the result when it appeared. The tests were made at the U. S. Arsenal, Watertown, N. Y., 1,160 nails being employed, and tried in lengths from 1⅛ inches to 6 inches. The object was to determine what is called the "holding power," that is resistance to end movement after being driven, which is the main function of nails, but not the only one. The result is such as to forever set the controversy at rest, the cut nails showing from 50 to 100 per cent. more holding power, as might be inferred. The wedging action due to taper, the roughness of the surfaces, and deflection of the wood fiber in the direction of the nail's course, are obvious enough. The displacement of a wire nail is mainly sidewise from its path, the surfaces are smooth, and there is no taper, so that all circumstances are against this class of nails for any but soft spongy kinds of timber. In some kinds of wood the cut nails required 135 per cent. more power than the wire nails to draw them

An Italian engineer proposes for the City of Rome an urban railway system raised above the houses, supported on towers and viaducts on a level grade independent of the undulations of the earth's surface. This may seem chimerical, but it is not so at all, and economically might be cheaper than traversing surface level occupied by buildings. Suppose, for example, elevated roads in New York were raised above the buildings, supported on towers and steel girders, leaving the streets in a measure unobstructed. The vertical travel from the lines to the ground would, under modern methods, be easier than climbing the present stairways. "Over" or "under" must eventually be the rule, and the "over" system may be the best, at any rate let us hope so. Fifty feet would take the main part of the New York system over the houses, and rid the city of a nuisance, besides the lines could be built on a straight course or near it.

The period of iron bridges, now forty years or more, has not been long enongh to determine the economy of the system in our climate, but one thing is quite clear, they are not a very lasting kind of structure. Some of the principal railway lines have quit building iron bridges of short span, substituting masonry, which will last for ages, and is in the end the cheapest. The deterioration of iron bridges is insidious, and inspection difficult if not impossible, and the time has now come when iron bridges will require very careful looking after, that is, the time since the first were made is long enough to cause dangerous deterioration. In the case of iron ships the same rule holds. We once heard a remark on this subject by a Scotch shipbuilder that illustrates the case. He was asked how long an iron ship would last. "I don't know," said he, "none have been built long enough to find out, but some time we will know more of the matter."

A model of the great steam hammer, designed by Mr. John Fitz, and built by the Bethlehem Iron Company, is represented at the Chicago Exposition by a wooden model, and to those acquainted with such matters must be an object of much interest, but to a farmer, and perhaps two thirds of all who see it, the impression will be that it is not as large as an average house, and hence is no curiosity, but to anyone who can realize or imagine the forces resulting from 125 tons falling 16 feet, the exhibit is quite another thing. The steam cylinder is 6 feet bore, 24 feet long, and the top is 90 feet high. The total weight is more than 2,000 tons, and exceeds any

other hammer made to this time by 25 tons in the falling weight. The next largest being that at Terni, Italy, in the Government ordnance works there, erected by Sir William Armstrong & Co. This great machine at Bethlehem is to be employed in forging ordnance for the Government. It is single acting, that is raised only by steam pressure.

Mr. S. M. Vauclain, the inventor of the system of compounding locomotives, adopted by the Baldwin Works, at Philadelphia, has informed the Engineer's Club, of that City, what his personal opinion is of these engines, and it is highly flattering to the system and himself. His invention consists in placing two cylinders side by side, attaching the piston rods of the two to one crosshead, and placing a piston valve for steam distribution to both cylinders, as nearly in the plane of the cylinders as possible. No one can dispute the symmetry and cheapness of the arrangement, which are strong points, especially in this country, but Mr. Vauclain's advertisement of his engine, by a pretended technical paper, is in bad taste, and strongly condemned in that respect by the *Railway Review*. There is difficulty in avoiding papers of this kind without offending people who are so unfortunate as to be ignorant of the amenities that should govern in such cases. Mr. Vauclain's paper is a good trade circular.

Boring machines for cylinders, and the like, have struggled on for half a century through all kinds of ingenious improvements and modifications, and now have emerged in a form that promises to be permanent, that is, they consist of a sole-plate, and three plain bearings for the boring bars. We had the temerity to urge this view of a boring machine upon one of the engineering firms in this City some years ago, and after thinking it over they bought a sole-plate as large as they could afford and handle, mounted some plain box stands on it, and began boring with a feed of four per inch or so, doing the work in half the usual time, producing cylinders straight and true. This machine soon cleared up all the boring that could be found, and the owners put a large face plate on the end of the boring bar, made a strong tool stand, and began turning rope sheaves, earning at the usual rates, twelve to twenty dollars a day. Our present mention of the matter comes from noticing in a foreign journal an almost identical machine by one of the best tool-makers in England.

LOCAL NOTES.

There has been announced another steel works at San Francisco, making at least the fourth one in the last few years, and, like those that have preceded, is founded on somebody's patent process. No good can come of these schemes, but a good deal of harm may and does result. There is no likelihood of any one person discovering a new steel-making process of any value, and if they did this Coast is not the place they would select for exploitation. Everyone here would like to see the addition of any permanent industry, but capitalists are not likely to invest in any undertaking of the kind, after considering the many steel-works schemes started here, seemingly to cause "talk." Steel is made at Pittsburgh for a cent a pound, and is now being carried here for one third of a cent a pound, and so long as iron castings cost here, three times this much there is little hope of steel manufacture that will afford a profit.

Those who would study the economics of small cities on this Coast can learn a lesson by visiting Napa, Cal., where the "boom" infection has not reached, and where the citizens have public spirit enough to keep the streets clear of idlers. Napa has fortunately a water outlet to the bay large enough to accommodate small steamers that make regular trips, and this, no doubt, has had a good deal to do with the founding of industries there, chief of which is tanning and leather working. There are also woolen factories, wine-making establishments, and others, enough to accommodate or absorb the labor of a population of 5,000. It would be an instructive lesson to go around the bay basin here in California, and note the effect of water communication wherever it exists, and contrast the towns so situated with those that have only railway communication. The contrast is marked and unmistakable. The water-way towns that have cheap freight to and from San Francisco are nearly all prosperous, permanent, and flourishing.

Mr. Julius Striedinger and Mr. Otto von Geldern, civil engineers of this City, have formed a co-partnership with the especial view of examining and reporting upon hydraulic mines applying for licenses under the recently formed U. S. Debris Commission. These gentlemen bring to their aid a wide experience and a professional standing that will warrant an acceptance of their views and reports by the officers of the U. S. Engineer Corps comprising the

Debris Commission. Mr. von Geldern has been for many years in the service of the Engineer Corps, and for a portion of the time engaged in the matter of examining and reporting upon this very subject of hydraulic mining, or the effects of it on navigation and arable lands, also in hydrographic surveys at various points on this Coast. Every facility is now offered to the hydraulic mines to present their petitions and proceed upon the lines they have laid down in respect to other people's rights and property.

The wheat crop of California is estimated at one million tons, or less than half it should be, worth $20,000,000, but will perhaps be sold for less. Prices now are much depressed, and the outlook for the agricultural interests is the same, or worse, than in other industries of the Coast. Circumstances of all kinds for two years past have seemed directed directly against affairs here in timber, wheat, and fruit, while the cost of goods we have to purchase remains without much change. An effort to cheapen carriage has been successful for the present, but this for a time will have but little effect, except to disturb values. The permanent benefit will come after some time only. The main incentive just now is to increase the profit on imported goods until such time as the consumers prices are adjusted to the new rate for carrying. A wide public spirit, which has in view general interests, seems wanting here, and coöperation can not be maintained beyond immediate and personal objects. We are not in a good way on this Coast just now, and had better admit it.

These dull times one would hardly expect new enterprises, but last month brought forward two of an extensive kind, one, a complete trans-continental railway line, the Great Northern, from St. Paul, Minn., to Everett, on Puget Sound, now completed, and the subject of a great demonstration at St. Paul on the 7th of June. The other a mere inception this far, but with much promise, a railway line from Denver to San Francisco. It is a curious thing, or rather, an unfortunate thing, that these new lines from the East come to the Coast at all points except the one where they all would naturally be supposed to end, at San Francisco. There is not much to be gained by discussing reasons for this. They are well understood, and just now give some hope of removal. The Great Northern is mainly the work of one man, James J. Hill, who, out of a wreck, has quietly and persistently built a line from the Mississippi to the Pacific Ocean, and with every chance of future success.

LITERATURE.

Quarterly Bulletin.

UNIVERSITY OF MINNESTOA.

We have received the first three numbers of this serial, and must admit that as a bulletin of an university it seems to be more nearly perfect in form and dress than any other that can be referred to.

It is set in double column, small pica, pages 6 × 9 inches, printed on the best of paper, in perfect dress, and is made up in a systematic manner. The first numbers naturally contain a good deal respecting the institution from which they emanate, but not too much, because the construction, to so call it, of these state educational institutions is just now a matter of interest.

The Northwestern States are certainly leading at this time in the way of state-aided colleges and schools. The result will appear some day in the near future. During the Civil War it was a matter of wonder in this and other countries, what a large proportion of the military and civil leaders came from Ohio. At one time it seemed as though that State had taken command, with Chase, Stanton, Grant, Sherman, Sheridan, and others at the head of affairs. The reason, we imagine, was mainly because of the educational "machinery" in Ohio. It far exceeded any other state in colleges of all kinds, but since then the Northwest has exceeded Ohio.

Minnesota has to a great extent been settled by an advanced class of people, and is destined, no doubt, to take a foremost place in a foremost section of the country in this matter of education.

Catalogue of J. A. Fay & Co.

CINCINNATI, OHIO.

Woodworking Machinery, 1893.

This Company, founded as a corporate one in 1865, has always presented their manufactures in a complete and attractive way by issuing, at intervals of two or three years, catalogues or circulars in book form, filled with finely executed engravings of the various machines made. Such catalogues to be complete are, in any case, a cumulative work. Each is an improvement on its predecessor, and thus through a long period of years the engravings, descriptions, arrangement, and make-up, grows through consecutive editions to a perfect form.

The J. A. Fay & Co.'s work in this way has culminated in a catalogue of 337 pages, 12 × 7½ inches, containing about 500 fine engravings, and descriptions of more than 300 machines, and parts or modifications thereof, for working wood. It will be but a moderate claim to say that no catalogue of the same extent was ever before issued by any firm or company engaged in this business, and a still more moderate claim to say that no other industrial catalogue has ever been issued in so fine a dress, or with engravings of the high class, and of such uniform excellence as is here shown.

The text of the work is written in the impersonal pronoun, consequently is free from the provincial dress that unfits much of our advertising matter for use in other countries, and for translation into other languages. The descriptive matter of the various machines is written in the form of specifications, plain and understandable.

That portion of the manufacture described, which will most astonish people in this country, is the fact of extensive sales of woodworking machinery in foreign countries, especially as such sales have to be confined to what we may call "finishing" machinery. It is no fault of the present company, or other makers, if the people in this country persist in employing methods of planing and coarse sawing that are different from other countries, and less perfect by all rules that we are aware of.

In the present catalogue, for example, there is illustrated a wonderful line of planing and matching machines, also moulding machines arranged upon the peculiar system demanded here, and as no firm could well prepare and maintain two systems of such machines, this fact has, no doubt, greatly reduced the amount of foreign trade that might have been done.

The present catalogue, if it has a fault, is one due to its elaboration, that is, it is too

extensive and expensive for circulation, but is, after all, only commensurate with the company's resources, and this objection may not apply.

The consolidation of the J. A. Fay and Egan Companies, since the compilation of the present catalogue, increases these resources, and must of necessity lead to divisional circulars instead of complete ones, so we can scarcely look for another extensive work of the kind.

Tenth Annual Report.

INDUSTRIAL STATISTICS, MICHIGAN.

Last month we mentioned the receipt of this volume from Mr. Henry A. Robinson, the Commissioner of Labor, and promised some farther notice of it. This promise we fulfill in an easy manner by a quotation from Mr. Robinson's preface, which will indicate his grasp of the subject treated upon; also the necessary completeness of any statistical matter prepared under such understanding of the equities and conditions of labor. The quotation selected is as follows:

"In attempting the solution of the social industrial problem of today much has been said about the efficiency of trades unionism, and the benefit of co-operation, profit-sharing, etc. These things, while useful at certain stages and in certain places, are not available as factors in the scheme of general and permanent reform. An examination of their mission and effects will show them to be but the crude instruments which must be used until a perfect mechanism can be put in smooth-running order. Trades unions are societies organized for the purpose of attempting by united protests to improve the conditions under which its members toil. It is effective only through the weakness of its antagonist. Be the antagonist financially strong enough it can laugh a trade union to starvation's door, and whip it back into the old tracks with the lash of necessity. Trades unions are certainly beneficial in a small way, but their work of good is necessarily limited as they deal with effects not with causes. Often the strike or boycott of a union miscarries and ruins some well meaning employer who is laboring under the oppression of the same system which is crushing the toilers.

Another of the propositions for alleviation is profit sharing. This seems to be a fine theory, but its practice, if universally adopted under existing circumstances would not to any extent benefit the people as a whole. Analyze profit sharing and see what it comes to — expert wages. Profit sharing means a division of the spoils after the running expenses of a business, the wages of superintendence for the employer and the interest on capital invested has been paid. Then the more there is produced the more will there be to divide, and consequently the laborer is stimulated to greater exertion, with the result of greater accomplishment. Hence the profit sharing proves to be but higher wages paid for more and better work. None of these so-called "remedies" deal with the cause of social disorder, and therefore, cannot be relied upon to improve permanently the social conditions, nor to satisfactorily adjust the dispute between employers and employés."

The Mineral Industry.

ITS STATISTICS, TECHNOLOGY, AND TRADE.

By RICHARD P. ROTHWELL,

Editor of the *Engineering and Mining Journal.*

The *Engineering and Mining Journal* have changed their plan of a special number giving the mineral statistics of the year, and instead have published this matter for 1892 in a neat bound volume of more than 600 pages, that will constitute a valuable library reference.

Mr. Rothwell, in his preface to the volume, points out the impossibility of avoiding errors in the mass of statistical quantities here given, but we imagine the whole is as correct as any extensive compilation of the kind can be made.

The facilities were more than can be commanded by any other private organization, and, as we observe, have excited the envy of at least one contemporary, that is evidently much annoyed at so pretentious an undertaking and its successful issue.

The volume includes the statistics of the principal mineral-producing countries carried out to such detail as can have any object of reference in this country, and is contributed to by fifty-eight different authorities of unquestioned standing in departments to which their work relates.

It will be understood in a notice like this that one does not read over such a book. That is the work of the coming year as the information is required, hence the general scheme and arrangement is all that can be commented upon. The value, or the proof of it, is prospective. We propose to keep the volume at hand, and expect to have frequent occasion to refer to and consult it.

Perhaps the best that can be now said for the volume is that every engineer, mine

owner, economist, and what we call "public men," should have a copy for reference now that this important industry is so classified and arranged that a moment's time discloses the main facts and quantities of the past year.

The price is but $2.00 in paper covers, and $2.50 in strong binding. Orders should be sent to the Scientific Publishing Co., New York.

Consular Reports.—Nos. 150 and 151.

MARCH AND APRIL, 1893.

The instructions sent out from the Department of State are sometimes unique, or at least unexpected. In the present case 45 pages of the March number are taken up with replies to a circular of inquiry respecting "Electricity in Agriculture, as a Method of Propulsion for Farm Machinery, and in the Propagation of Plants."

The result was not wholly barren. In Germany especially the influence of an electric current on vegetable growth had been experimented upon, and, in the usual method of that country, the results had been carefully tabulated, showing an unmistakable influence on various growths. Also from Birmingham, England, came a long essay on the subject, and in Belgium some account of electric transmission of power to threshing and other farm machinery.

Another section of this Report deals with the manufacture of cream of tartar, extensively used in baking powders, and an article that may some time form a part of our industry on this Coast.

Consul E. L. Baker, at Buenos Ayres, Argentina, contributes one half of the report, No. 151, on the affairs of that confederation, which has formed the subject of voluminous former reports. In fact the Argentine statistics have, as we may say, grown stale.

The present report is, however, a resumé of the various circumstances that have gone to make up the history of the country for three years past. The President, in a message last winter, laid down with much clearness the causes that led to commercial disrepute of this country. We quote a part of his address, which indicates a high degree of knowledge and penetration.

"We have not inherited such aptitudes and political habits since the brave and audacious adventurers who discovered and dominated our portion of America, much less the native Indians who served as the base of the great mass of our people, could not transmit what they did not possess. It is only through the medium of political education that we can acquire such modes of thought and action — an education which could not be attained during the boisterous days of our colonial existence, nor during the rule of anarchy and tyranny which succeeded, and certainly in the short space of forty years since we assumed the forms of constitutional law we have not become penetrated with the significance of free government.

Our political regeneration must be a work of patience and labor. It is especially necessary that men and parties should be convinced that the country does not need the services of liberators, statesmen, or restorers of law and order, who first invoke the laws and the constitution, then proceed to incite the people to violence and anarchy, and conclude by seeking to suppress all regular government and reestablish in its place a personal despotism. But the country does need citizens who, while freely exercising their political rights, proclaim as a fundamental principle that violence and anarchy are unpardonable, whether they are in or out of power, and that it is only by the reform of our bad political habits that the Argentine Republic can ever become a worthy illustration of the beneficence of free institutions."

Consul Wallace, at Melbourne, Australia, sends the particulars of the American timber trade in Victoria, of which we already know a good deal. The present price is $19.00 to $24.00 per thousand feet, of which about one half is tax or duty. The rate is assessed with respect to dimensions, for what purpose no one can tell, unless to make confusion. For example, Oregon pine under 7 × 2½ inches, $12.00 per 1,000 feet; under 12 × 6 inches, $6.00 per 1,000 feet. The former size includes, of course, nearly all building timber.

The importations from this Coast for five years past of flooring, lining and weatherboards is, counting millions of feet only, as follows, beginning in 1888: 55, 35, 35, 20, and in 1892 down to October only 11 millions. In laths, pickets and doors the falling off has not been so much, but near it.

The freight on timber from this Coast is set down at $9.00 to $9.60, which added to the duty on Oregon timber of the smaller sizes would leave the mills here less than nothing, in other words the trade is about $10.00 per thousand less than possible.

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"INDUSTRY."

JOHN RICHARDS, EDITOR.

ISSUED MONTHLY BY THE

INDUSTRIAL PUBLISHING COMPANY

SAN FRANCISCO.

FOUNDED 1888. AUGUST, 1893. No. 61

A WEEK IN THE WILDS.

BY THE EDITOR.

One hundred miles or so east of Superior and Duluth, near the head of Lake Superior, there is a peninsula extending into the lake, not so bold or so long as Keewenaw, still farther east, which projects out like the pole of a wagon into the vast lake, and on which are Hancock, Houghton, and the great copper mines. This upper peninsula has been, in ages past, frayed and split at the end into now detached portions called the Apostle Islands, so named because there was a dozen of them, also because the first explorations there by white men were made by the old French Fathers who always hunted up some kind of a sacred or church name for all kinds of places, whenever possible.

In the little bay at the mainland, abreast the principal Apostle Islands, is Bayfield, Wisconsin, now, I am told, an enterprising town with a population numbering some thousands, but at the date of this narrative, 1868, only a hamlet with a kind of Summer hotel, some Indian huts, camper's cabins, and a Government land agent, the whole not exceeding a hundred people, perhaps not fifty. Senator Rice, of Minnesota, had a curious log house there, set up on posts twelve feet or more above the ground, where he came and lived in Summer for a time, to be shut out from the world as one might say.

On one of the Apostle Islands was an old church built by the

Fathers just a century before, while on their way, it may be called, from Lower Canada to the Upper Mississippi, had left their names in La Salle, Joliet, Marquette; also French names like Des Moines, Prairie Duchien, La Croix, and more. The country has therefore been twice discovered, so to speak, by the French Fathers about 200 years ago, and by the modern improver about twenty-five years ago, when classic Duluth was founded.

The Chippewas (Ojibways) were there at first, and are there now, but sadly altered in these later years, in some ways for good, in other ways for bad. They are Indians still. All the blessings of civilization, as we call it, pressed upon them by all the arts known to proselytism for a hundred years past, has only in part erased the old instincts, customs and mode of life, as our narrative will show.

In 1868 a company of a hundred or more excursionists went up the Lakes on the *Keewenaw*. It was her last trip for the season. The journey is one of the most interesting for tourists that exists anywhere in this country. The excursions begin at Buffalo, and end at Superior, 2,500 miles distant by the water course through Lake Erie, the St. Clair River, Lake Huron, Sault Ste. Marie Canal into Great Superior, and out to its very apex, a sharp tongue of water reaching away into the Northwest, as lake Michigan does at Chicago.

The trip we name was in the later part of September, or the first of October, after which there is danger of storms, cold weather and ice, ending the excursion business. The Portage, as it is called, an estuary that reaches into and nearly across the Keewenaw Peninsula and forms the only waterway to the copper region, is the first place closed with ice, and when these places were cut out at that day there was not business enough in the upper lake after the first of October to justify a large steamer going up there.

The *Keewenaw* was a large paddle steamer with a beam engine, and the usual amount of "top hamper," a full saloon above, a second deck, with a "Texas" still above, very like a river steamer, but immensely stronger. We had a fine journey. The owner of the boat, Captain Ward, and other people of prominence in the lake region were on board, and no pains were spared to make it an excursion trip. The weather was fine all the way until we entered the bight of Lake Superior, and began heading in to Superior City, where we met a gale of wind.

It was a new experience to most of the passengers. The spray rose in clouds over the bow of the steamer, and the jar and concus-

sion seemed dangerous. The wind drove the water out of the harbor at Superior, where there was barely depth enough to enter in calm weather, and when about ten miles from the harbor the *Keewenaw* came down flat on the sand, and shook up every joint in her framing. The shock was terrific. The skipper called down to the mate to shift the chain boxes to port, as well as all movable weights, shouted to the steward to call the passengers to windward, and then flew up to the roof to wear the ship and turn her in the seas.

I clambered up after the captain to see what would occur, he saw me and said "keep below." I pretend not to hear, and held my ground. The boat began to swing, and when the wind caught her on the port side, and she fell into the trough of the seas, I was sure she was gone. The angle of the roof was such that I would at once have slid off in the sea if it had not been for a projecting stove pipe which furnished a mooring. She went round however, and in five minutes was scudding before the wind on an even keel.

I went down below into the cabin, and there was chaos of all things animate and inanimate. The steward declared with profanity there was not a whole dish on board. The chairs were piled up against the leeward bulkhead, and passengers, such as were not in hysterics or hurt, were running about nearly distracted. I have since then been buffeted in the English Channel, shook up in the German Ocean, pounded in the Baltic Sea, and seen a mid-winter hurricane in the North Atlantic, but never have seen cabin hamper so nearly smashed to pieces as on this occasion.

At least one half of our passengers were booked to Superior to cross from there by stage to St. Paul, two hundred miles between the Lake and the Mississippi, but this disappointment was not thought of then. We ran back about fifty miles, and then stood in for the Apostle Islands with the wind on the after quarter. This produced a peculiar motion conducive to seasickness, and, as the excitement had gone down, every one not a sailor was in misery. They did not care about Superior, or any other place, and seemed indifferent then as to whether the boat sank or not.

At five o'clock we made Bayfield, Wisconsin, and landed there. Everyone scampered for the shore and soon got over *mal de mer*, to think of the disappointment of having to go back to Marquette, and a long journey by rail get to St. Paul, or else give up the trip. For myself, I had sent a gun, fishing tackle and some business matters from Cincinnati to Minneapolis, and had no idea of abandoning the journey. As the steamer was rounding in to Bayfield, I remarked to

a friend that if some one would join me, I would go ashore there, and in some way make my way back 100 miles to Superior.

A tall, fine-looking young man who stood near was listening. He came forward and said, "I am your man; here is my card. I will stop here if you say so." I was pleased with his courage and appearance, and the bargain was at once concluded.

We took our baggage ashore and went to the little hotel, the passengers laughing at us and bantering us about such a ridiculous venture as stopping there off the last boat of the season, and not one of them believed that such a fool-hardy thing would be done. My companion, Mr. Charlton, a Canadian, coolly lit his pipe, sat down on the wharf, and we waited there, watching the steamer move away, swing, and start on her journey for home.

Charlton proved a man of infinite resources and "grit." He was a woodsman, skilled in all craft of that kind; and I a waterman, all my life about or on that element. I proposed a boat and return to Superior. "Boat it is," said he, "I am ready for anything."

Next morning, after a rest, we scoured the little town and found a boatman who said he would go to Superior if we would help him "handle," and the weather bid fair. We informed the hotel proprietor of our intention, which called out remarks about as follows:

"Go to Superior in that boat! You are crazy. A fifty-ton schooner could not do it. Why, its blowing forty miles an hour outside the cape, and will be till next Spring. There are no harbors you could find, and the wind is off-shore all the way after you round the point. You had better buy some grave stones and be buried here on land, dry and respectable."

This settled the boat scheme. The host was an old lake sailor, and understood the matter fully. We gave up the idea.

That evening, after supper, Charlton went out and made the acquaintance of the U. S. land agent, coming back to the hotel about 9 o'clock for some wine and a box of cigars. He returned again about 12 o'clock, to say the agent had agreed to let us take his surveying wagon across to St. Paul, or to Sunrise, on the St. Croix River, from where we could reach St. Paul without difficulty. He informed Charlton there was nothing but a trail, perhaps no bridges, and no one crossed there except an Indian, twice a month, with the mail carried in a package on the top of his head. The distance was two hundred miles through an unbroken forest, with only an Indian station here and there, a day's journey apart, where the "mail" camped.

The next day Charlton found an Indian who had two ponies and agreed to take us to Sunrise for $35.00; we to furnish everything but the horses, and insure against accident to them. We closed the bargain, and I undertook the commissary duties of the expedition by contracting for a bag of bread, those indigestible masses called "biscuits" in the western country; boiled fowls and a ham; four bags of oats; an axe; some tobacco; *aqua vitæ;* our luggage, and an old shot gun, with one barrel operative, made up the equipment. That evening we loaded up our wagon, inspected the horses, the Indian, and other details, and then went out on the route three or four miles to fish for trout and stay all night in a shingle camp. We caught a fine lot of these fish, which are plentiful in all streams flowing into the lake, but not in streams flowing the other way, to the Mississippi.

At 9 o'clock the next morning, our wagon, the Indian, and outfit came along. We lit our pipes, climbed up to the after seat in the wagon, and settled ourselves for a comfortable ride to Sunrise, on the St. Croix. The Indian, like all of his race, was taciturn, saw everything but made no sign, and to this day I know not if he understood what we said. When we climbed up on the wagon seat I heard him chuckle and saw him hide his face. We started, and in five minutes the Indian shrank down into the front of the wagon below the seat, and the next minute Charlton and I were ignominiously brushed off by the low limbs of the pine trees. We took a survey of the case, and saw at once that there was no such thing as riding on the wagon. Charlton climbed up again for another trial, and I took the gun and went ahead on the trail.

The scene and surroundings were novel to me. The forest was wild, dark and still. The trail this far was clear, beaten by the Indians who gathered whortleberries and carried them out to the lake to be sent down to Detroit, Buffalo, and elsewhere. These berries grow in profusion there, not in the forest, but in the burnt lands which we began to cross about ten miles from the coast. These berries are also dried or preserved in some way by the Indians, for Winter use, and are certainly a refinement on ordinary Indian food.

By improvising bridges, cutting trees out of the trail, and working hard, besides tramping, we made 20 miles, reached "Spider Lake" and camped for the first night. "Spider Lake" deserved its name; after trying for some time to dip up a pail of water without having a swarm of water spiders in it, the attempt was abandoned and we strained some through a cloth, enough for supper.

The mosquitos were there in legions. I had learned to combat them in Arkansas, and Charlton had done the like around Lake St. George, so we managed to sleep some, and reached a second day on the journey. This was much like the first, but the lakes, of which there were many, changed in their nature as we left the coast. Anent this matter I must digress here to note a fact which seems to controvert the common theory respecting the genesis of prairies.

Soon after we left the coast, and gained the general level of the country, there appeared pot holes or sinks of small size from fifty to a hundred feet in diameter. These seemed to be excavations and looked strange, because in any country covered with clay soil, such holes or basins if they existed at all would be filled with water. Here they were dry down to the very bottom, where there was usually a thick growth of American sarsaparilla.

The whole country seemed to be covered with sand, only a light mold of vegetable matter on top under the timber, decomposed litter of the fir growth. These pot holes became gradually larger as we left the Lake coast, and at thirty miles or so began to have some water at the bottom, with clean shores, so one could approach the edge. The basins grew larger, so did the water at the bottom, until a fringe of grass appeared around the margin. This grass fringe grew wider as we went on toward the "divide," or where the watershed was westward. Soon we could not approach the water at all, because of the bog that surrounded it.

As we went on, the grass and bog grew wider, and the water less, until only a spot in the center, and finally disappeared altogether, the basins all the time becoming larger, flatter, and shallower, until the little pot holes near the coast had developed into prairies of grass, small at first, but growing larger and larger and more solid until the transition was complete, and finally until the timbered or higher lands became the exception, and we were in a prairie country.

This strange matter I have never heard discussed or considered, and imagine it forms an interesting geological fact. Of course no one would attempt to account for the treeless plains of the West on such a hypothesis, but the spots of prairie, such as are found as far east as Northern Indiana, and all over the high Northwest, have no doubt, such an origin. The depressions, from pot holes to basins of thousands of acres, I must leave to those more familiar with those remote causes that give to the face of earth various features of the kind.

Getting back to our journey, the second night's camp was like

the first, unless the quantity of mosquitos was more. It was about the last days of their career, and white blood was not a common repast around these lakes. We had ducks for supper this evening, and on other evenings, and here were ducks that would please an epicure. In these highlands there is fresh water and pure feed, and there was none of that pungent fishy flavor of the salt water varieties.

It was a most interesting thing to watch our Indian driver bring down ducks, they were flying overhead from one lake to another, at high speed and in straight lines, and how that son of the forest could see them, apparently without looking up, was a mystery. The old one-barreled gun he kept carefully in a kind of cloth cover, and while moving along we would observe him suddenly drop the lines, unstrip the old gun, and about the time he would bring it to position, the ducks would come in view. He rarely missed, and his seeing them coming was less mysterious than his finding them after they came down.

I tried myself to find them in the high grass and rushes around the lakes, but as well might have searched for the proverbial needle in a haystack. The Indian would get down, move stealthily into the high grass, his black eyes glistening, and by some sign, perhaps some mark beyond or some disturbance of the vegetation, he would walk straight to a duck and pick it up.

On the third day out I shot a raven, and have never ceased to regret it; the plumage, jet black, was yet the most gorgeous imaginable, and in the sun gave the most beautiful changing hues like the gloss of satin, but finer.

Eagles, or large hawks, were never out of sight, and the scream of terrified quail and grouse was heard at frequent intervals. The hawks would sit perched on the tops of the highest trees, usually burnt ones without foliage, and to see them dart down on their victims was terrific. It afforded a problem in dynamics. One would think that to stop within a few feet would kill them, and my belief is they do not stop, but brush over their prey, stunning or confusing it, and on a return swoop seize it.

On the fourth day out we reached a regular camp or residence of a civilized Chippewa who had built a house, or several houses, some of them of whip-sawed boards or planks, and here we learned a good deal of Indian customs in that country. Our host showed us religious service books, printed in his language, and had the interior of one of his houses quite covered with pictorial sheets from various serials.

He was a mighty hunter, and that year had to his account thirty-five deer, several bears, and a collection of pelts from smaller ani-

mals. He had been wounded by a bite from a bear that crushed one of his knees, and was lame. Our man had some ducks which were to be prepared for supper. These were turned over to the women, and it was a marvel to see how soon the feathers were stripped and the game potted. We had here corn bread, potatoes, and coffee, all prepared out in the forest away from the house, the host explaining that Indians never cooked in the house or staid in it during the summer.

We were asked if we wanted fish for breakfast, "very fresh and just caught," the man explained. I made him promise to wake me in the morning to accompany him on the fishing excursion, which he did. He went to a stream near by, where there was constructed what is called a "fish pot" in this western country. It is an Indian contrivance, or trap, made of small poles, and is a sure catch for any fish descending the stream. There is a dam and an overflow or waste way, the water pouring over on a bed of small poles set at an inclination of twenty degrees or so, pointing back under the dam where there is a pool to contain the fish. When one goes over the dam, he lights on the screen of poles through which the water escapes, and wiggles back into the pool without hope of escape.

The Indian took a kind of rake and drew up on the apron, a "pile of fish" two dozen or more, and after selecting three or four black bass, he raised some poles in the bottom and let the remainder out; they went down the stream by scores, on their journey which had been here so mysteriously interrupted.

"Much more tomorrow" said the Indian, and we went back. While eating our breakfast we had an example of his skill with a rifle that I am almost afraid to relate. A large hawk came down among the fowls around the house, raising a great commotion. The Indian sprang up, seized a rifle from the wall, and ran out, we followed to see the fun. The hawk was sailing around in a circle at least three hundred feet high, quite steady, and watching us. The Indian braced himself, pointed his gun, and kept moving it with the hawk for some time and finally fired. The huge bird came down like a stone, but I must always think it was an accident, because the Indian was so elated over the feat.

The next day brought us to the St. Croix River, a large, rapid stream even at that season, which we forded with difficulty and risk, and in the evening were again among white men and civilization.

This, only twenty-five years ago, now a railway and farms all along the same route! Bayfield a commercial port and small city, the Apostle Islands a popular summer resort!

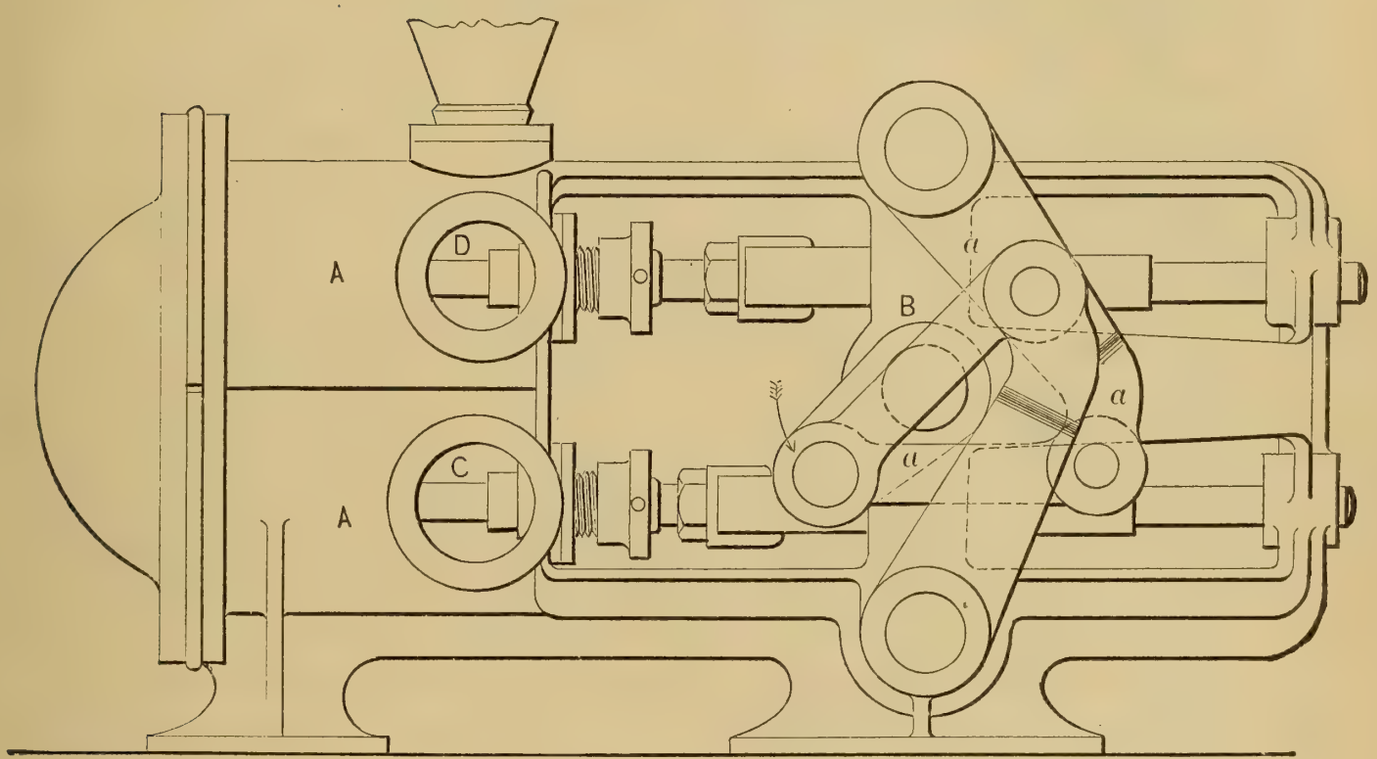
NOTES ON NEW AND PATENTED INVENTIONS.*

BY J. RICHARDS, IN CASSIER'S MAGAZINE.

No. VI.

U. S. Patent No. 482,944, Sept. 20, 1892.

M. W. Hall.—Pumps.



Mr. Hall, the inventor of the pump described in the above patent, has already contributed some valuable features in such apparatus. His duplex pumps, which received the honor of an award of the Scott medal by the Franklin Institute, of Philadelphia, are among the unique, as well as valuable improvements in the intricate art of "moving fluids," as Mr. Hawksley, of London, calls it.

These pumps are very well known as almost the only duplex type with steam-moved valves, and operating by a peculiar motion of the pistons that permits the valves to close easily at each end of each stroke. This was a successful attempt to improve the action of pumps, but not to alter the methods or principle, to so call it, on which reciprocating pumps act.

*Copyright by the Cassier Magazine Co.

Since the introduction of the Hall duplex pumps there has been a good deal learned respecting internal forces set up in pumps with intermittent flow. The diagrams of Professor Riedler, recently mentioned in these articles, disclosed operating conditions, even of high-class pumps, that were a revelation. He pressed reform as far as one man usually does in such cases, but it is evident to most persons that much remains behind. He increased the speed of pump pistons from 100 feet to 300 feet a minute, and closing valves without noise or jar, but he "closed" them, consequently only improved the old methods, adding "positively moved" valves, improved water ducts, higher efficiency and doubled the duty.

Now there is dimly seen a possibility of the valves of such pumps not closing at all, and of a continuous flow. We can also see approaching some recognition of the fact that crank motion is not adapted to pumping at all, that is to economical and still pumping, and that the water following the ordinates of a crank curve is a most unnatural kind of operation.

This we know is a revolutionary proposition considering how great a share of our water pumps are operated by cranks, but if one will stop to consider a body of water fifty to a hundred feet long, weighing 62.5 pounds to a cubic foot, following the variable movement produced by a crank, it will seem absurd. Suppose, for example, hoisting machinery for goods or passengers was operated on such a method, and that the load was picked up by half strokes of a crank and so propelled, no one would think of such a thing, still this is the common method of raising and forcing water from the intake to the air vessel.

These remarks bring us to Mr. Hall's present patent. It contains a large number of drawings and diagrams, only a small portion of which are reproduced here, only sufficient to illustrate the main features of the invention.

In the drawing above, which is a side view of one of the pumps, *A A* represents two pump barrels arranged in the U form, and equivalent to one straight barrel with the two bucket-pistons moving in opposite directions. It is equivalent to "bending the barrel around," so to speak, so the two pistons, instead of moving oppositely, can move together. It is not a common arrangement, one adopted at first, so far as we know, by Swiss makers, and called valveless pumps, because no valves are employed except those in the pistons. *C* is the inlet, and *D* the discharge way.

In the present case, however, the pistons do not move together,

but with a rapid inward and slow outward or working stroke, controlled by the driving cranks *B* and *a a*, with links and levers as shown, producing an uniform working movement as indicated in the diagram, Fig. 2, which is thus referred to in the specification :

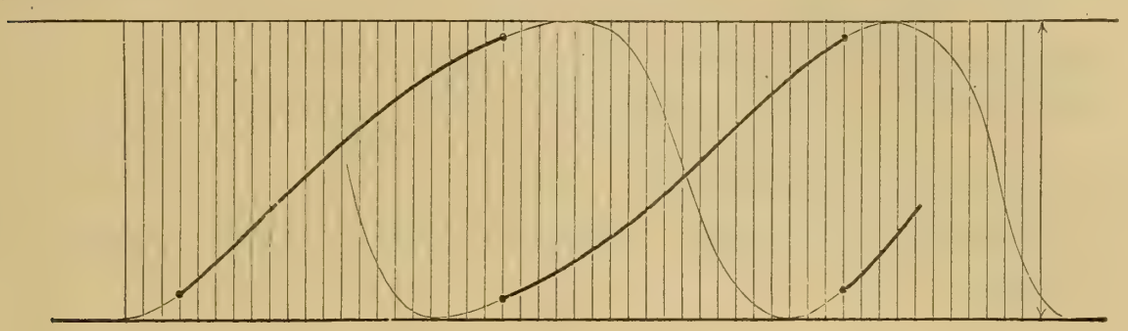


FIG. 2.

"Fig. 2 is a chart showing graphically the relative movements of the pistons, the vertical lines being spaced apart to represent equal intervals of time — namely, thirty-sixths of a revolution, or ten degrees — while the curved lines indicate the positions of the respective pistons at the successive intervals of time."

In another part of the same specification there are the following words relating to continuous flow :

"Pumps as ordinarily constructed impart an intermittent movement to the column of water, the column being first lifted by the thrust of the piston, and coming to rest and remaining seated against the check-valve during the return stroke of the piston, so that upon the beginning of the next stroke the column has to be again started against the resistance offered by its inertia."

These double-barreled bucket pumps are by far the nearest to producing a continuous flow when operated by direct steam pressure or other means of producing an uniform rate of movement during the working stroke. This is precisely what the inventor is aiming at, and has accomplished here, as is set forth in a preamble to the specification, but one cannot help wishing the crank eliminated when it involves expensive gearing subject to wear, and directed to functions which it seems should be attained without a crank at all.

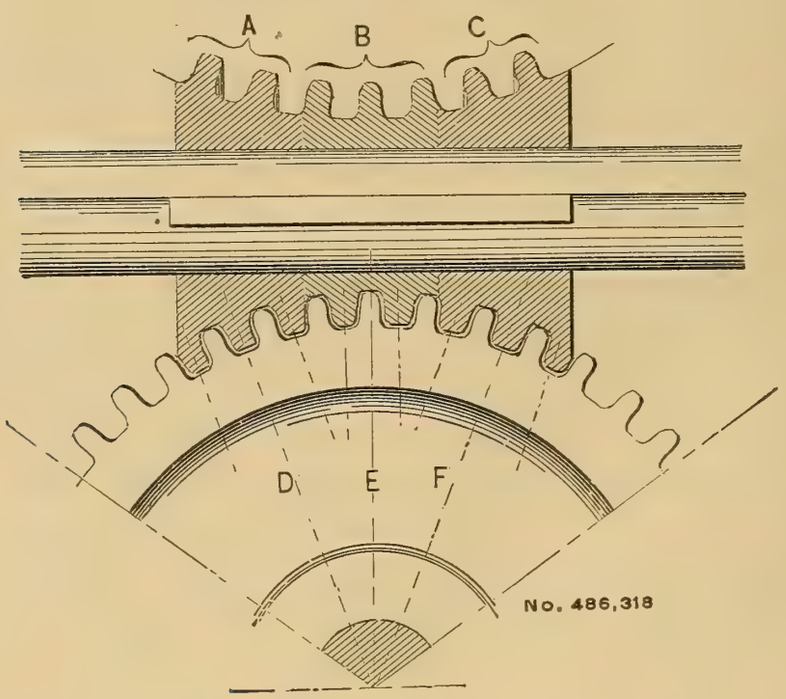
The functions and results foreshadowed in the present invention, if we mistake not, point to some entirely new modification of pumping apparatus in the near future. We have gone on for some centuries raising and forcing water by "jerks" instead of pushing it, a method that would not be thought of in connection with any other kind of mass having equal weight, or any appreciable weight for that matter. A reason for this is that in all of our conceptions of fluids their mobility is the chief characteristic, and we do not con-

ceive of a six-inch pipe filled with water being the same in weight and much less elastic than a bar of iron 2¼ inches in diameter of the same length.

Just at the time of writing this there came to hand an account by Mr. Arthur Rigg, of London, of a high-speed continuous-flow pump employed in a water works near London. It is of the bucket plunger type with tortuous passages, but capable of continuous flow to such an extent as to avoid shocks. Mr. Rigg is an engineer of good professional standing, and we mention his views as coinciding with what has been written respecting pumping by "jerks."

U. S. Patent No. 486,318, Nov. 15, 1892.

Albro.—Worm Gearing.



The geometry and literature of worm gearing, or tangent gearing, which is a much better name, is voluminious and complete if it were not for the idiosyncrasies of the gearing itself, and its refusal to conform to the graphic and written laws laid down for its operation. Of this, however, we will speak further on, first noticing Mr. Albro's proposition, above shown, to divide the screw into three portions, as shown at *A*, *B*, *C* in the drawing, the transverse axis of the thread or convolutions being on the lines *D*, *E*, *F*, radial from the center of the wheel, which seems impossible unless the screw is cut by a milling tool.

The inventor says one object of this construction is to provide for cutting the screw or worm in an ordinary lathe, in which case the axis would be parallel for each convolution on each section of the screw, but this is no matter if the pitch of the two sections *A* and *C* can be attained, or made to correspond to the angular velocity, there will be three bearing points in the gearing. This is the main object of the invention, and is certainly a feature of much value when accomplished by any means, or in any manner.

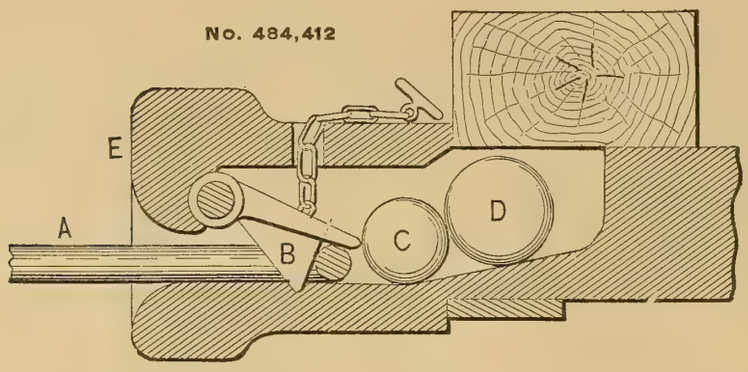
The best that can be done is a "short line" of contact, and that seems to be sufficient under reasonable strain or pressure if the conditions are correct, and this brings us back to the original remarks as to the behavior of tangent gearing. Such gearing sometimes wears out at once, irrespective apparently of strain, want of lubrication or other discoverable cause. Again it will go on for a decade without much care, attention, or even the cleaning that all sliding joints are supposed to require. It is a kind of mystery to the practical man, until by evolution or accident he hits upon the required pitch, shape of teeth, and other conditions that give longevity and comfort.

Without considering the written graphics and theory of the matter, the first problem in the workshops when such gearing is made is where shall the pitch be taken for the wheel? At the center, base, or end of the teeth? That is, at what point on the teeth of the wheel shall the pitch be the same as that of the screw? There seems to be no determinate reason why the pitch should be taken at one place more than another. The shape of the teeth is rapidly changed as the pitch line is moved out or in, but the operating conditions seem the same, so it becomes a problem of relative strength between the teeth of the wheel and the convolutions of the screw, and it is safe to assume that no rule is applicable in all cases.

If, for example, the wheel is to be of cast iron, and the worm of steel, then the greatest strength possible should be given to the teeth, the pitch being taken near their base. Then again the shape of the thread on the screw determines the form of the teeth or the opposite, but chief of all is the main fact that, as before said, no one seems to know when such gearing is to operate without wearing out, and "disintegrate" itself by abrasion, until experiment has settled the matter.

U. S. Patent No. 484,412, Oct. 18, 1892.

Foster Dickie.—Car Coupling.



Among some thousands of ways that have been invented for connecting together railway cars, none seems to meet the ideal of railway people, and one feels slowly inclined to think that the plain links, hook and turnbuckle of English and Continental trains as nearly perfect as any other mode of connecting.

There is certainly something incongruous in great beetle-headed structures one sees on modern passenger coaches in this country. It is, of course, not fair to criticise without understanding all the conditions of use and abuse, but why it should require five times as much metal to connect a train in one case as in another, is certainly an open query. Perhaps it is on the principle of those obscure causes that require half a ton of railway carriage to haul a passenger on smooth iron rails, and only a hundred pounds or so of land vehicle to haul the same passenger over cobble stones and all kinds of rough roads.

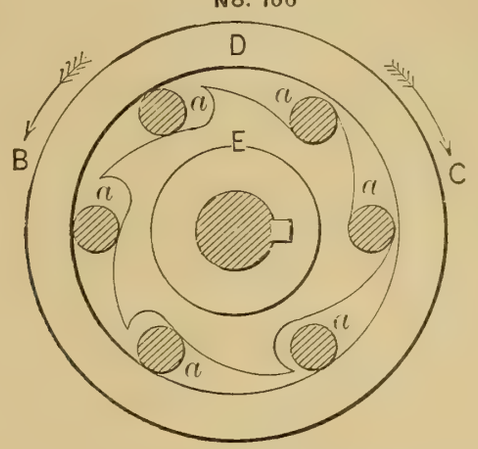
In the present coupling will be detected a novelty in the rolling detent balls *C*, and *D*. *E* is the main head, *A* the coupling link, and *B* the key latch or pawl that holds the link. When the pawl *B* is raised by the chain shown on top, and the link withdrawn, the smallest ball *C* rolls under the pawl and holds it up until a link is again inserted, pushing the balls back to the position shown in the drawing. The rear or larger ball is required because the front one rolls on a nearly level plane, and requires the larger one as a driver.

Here the reader may ask what the balls are for, inasmuch as the pawl will be lifted just the same when a link is inserted, and there seems no reason for holding it up in the interval, or when not in use.

This we cannot answer and need not, because the purpose is to call attention to the peculiar functions of rolling detents of the kind in cases where such appliances are subjected to jar and concussion.

The more they are shaken the more tenaciously they perform their function, and the principle is applicable in a wide range of cases where screws, split pins, springs, and other contrivances cannot be relied upon.

No. 100



Another example of the rolling detent is shown in Fig. *A*, a kind of clutch frequently employed on the Pacific Coast in the case of reversable winding gearing for elevators and light hoisting apparatus. *E* is the keyed on or fixed part, *D* the driven or detaining part, commonly a friction wheel embraced by a strap or clamp. When moving in the direction *B* the rolling detents *a* offer no resistance, but in the direction *C* they "jam" on the upstroke and hold tenaciously. These parts *a* are steel pins cut off a round bar, their diameter about half that of the shaft to be connected, and their length about two diameters. With fair castings no fitting is required, the whole goes together "in the rough." The method is, of course, confined to horizontal shafts.

JOHN FRITZ.

We have received from Mr. J. F. Holloway, Past President of the American Society of Mechanical Engineers, and now President of the Engineer's Club, New York, *A Reminiscence*, a finely-printed *brochure* giving an account of an anniversary dinner and reunion given in honor of John Fritz, chief engineer of the great works at Bethlehem, Pa., September 28th of last year.

The event in all of its phases and results was one of the most completely planned and executed that has ever been carried out; a model of humor, delicacy and pathos that must have left a lasting impression on those fortunate enough to be of the number present.

The attendance included the most notable men in the profession, and to fill in the inevitable blank that usually spoils such reunions, there were no prosy professional speeches, but John Fritz was indicted, arrested and tried upon a dual charge of pretending to be an engineer and of disturbing the peace of Bethlehem, Pa., by the erection of noisy and dangerous machinery and plants there, where all had been peace and quietness before.

Chas. H. Loring, assisted by five eminent associates, was Chief Justice. Mr. Holloway was the Attorney General in this prosecution, and Mr. R. W. Raymond chief counsel for the prisoner.

We much regret that our space does not permit reproduction of the whole *Reminiscence*, but we cannot refrain from reprinting the indictment of the grand jury, which will convey a very clear idea of the spirit and nature of the proceedings. It is as follows:

"May it please the Court, the Grand Jury, composed of hangers-on about the Court, shoemakers, tinsmiths, carpenters and joiners, members of Congress, briefless lawyers and clergymen on call, being duly sworn, and all (except a few from New Jersey) being citizens of the United States, and good men and true, having been informed that one, John Fritz, of the Borough of Bethlehem, County of Northampton, State of Pennsylvania, had said in the presence of reliable witnesses, that he believed that he could make a rail train, and that if he had a chance he thought he could build a blast furnace, blowing engines and all; that he had been known to aver that if he had given him the right kind of stuff he could make steel; that at sundry times and places he has been known to attend gatherings of iron and steel makers, had gone to meetings of engineers, and had then and there talked about tensile strength, carbon, phosphorous, etc., and about three-high rail trains, about expansion, and on one occasion was heard to say that he knew about

pumps, but he afterwards retracted and said he thought he knew about them, but had since learned that he was mistaken; that in this and many other ways he had endeavored to mislead the public into the belief that he was an engineer, and an iron and steel maker. The Grand Jury hearing that many persons calling themselves engineers, and iron and steel makers, were going up and down through the land persuading men to put money into works making iron and steel by all kinds of processes, but mostly by short-cut processes, and into building machinery, which, if it worked at all, worked directly the opposite way from what it was intended and promised, the Grand Jury felt it their duty to investigate as to the antecedents of this man Fritz, and to ascertain, if possible, whether, by reason of his education or practice, he had any right to call himself an engineer, so that if he had no such right he might be prevented from inflicting injury and bringing serious loss upon the honest but too confiding citizens of this Commonwealth.

The jury find that this aforesaid Fritz, who now sets himself up as an engineer, was, and ought now to be, a farmer; that he was born and raised on a farm in the township of Londonderry, county of Chester, State of Pennsylvania, near Doe Creek; that, when he was large enough, he split wood to heat up his mother's brick oven, and was paid for so doing with a 'turn over' baked after the bread came out.

Then later on he rode the old white horse bare back while his father held the plow through the rows of the waving corn. That later still he rode the same horse over to the grist mill, where he waited for his grist to be ground. The jury have ascertained, from sources entirely reliable, that in the summer time, and while waiting for his grist, it was the practice of this pretending engineer to roll up his tow pants and wade in the tail race and watch the big water wheel go round.

It was not clearly proven to the jury whether it was in watching the movements of the big water wheel or listening to the merry rattle of the damsel as it fed the corn into the eye of the millstone, or in gazing at the wooden cog wheels as they rolled together, or listening to the knocking of the revolving reels, that the idea first came to him to wish to be an engineer, but there is no doubt it was then and there he was first filled with ambition to the extent that he said to himself, 'If I ever grow up to be a man I will make the wheels go round too.' The jury being well informed as to the education of engineers, as they are annually being turned out in great numbers from our colleges, each one having a long roll of parchment paper tied up with blue ribbon, they investigated as to the college from which this man graduated, and they found that his entire education had been obtained in his attendance at a red school house on the hill, about two miles away from his home. That he spent there several winters, in terms of three months' schooling, for the reason that at that time of the year the business of plowing was rather dull. In addition to this splendid opportunity for procuring

an education he also attended several evening spelling bees, and was assessed, as all the rest were, to occasionally bring a candle. While it is possible that he may have graduated from this institution with high honors, he cannot now prove it, because the master he once helped to "lock out" is dead, and his diploma (if he ever had one) has been mislaid. It was also ascertained that the education of this pretending engineer received some extra polishing touches at a 'night school' which he attended (whenever he could get a chance) which was situated at the cross roads down near the creek. It was known as the Blacksmith Shop. Here on winter nights he would perch himself on an empty keg at the back of the forge, with his head in the smoke and his toes in the warm ashes; he by the hour watched the blacksmith heat and pound, bend and weld, the iron as he formed it into shoes for horses or irons for the wagons, listening the meanwhile to tales of spooks and Indians told by the old settlers as they sat around the smithy and smoked, until his creeping hair almost raised his cap while he waited in patience for some one going his way to start for home. While the jury (at least some of them) recognized the country school and the blacksmith shop as valuable aids to an education, as a whole they do not believe they would at this time warrant anyone in calling himself a 'mechanical engineer,' or an expert in making steel. The jury further found that this man in his younger days left the farm and the profession of agriculture, of which he would, no doubt, have been a shining ornament had he continued in the way he began, and went up to Parksburg and took the position of 'cub' in a country machine shop having as well a foundry attachment. Here he, so to speak, let himself out in repairing and renewing lame and spavined horse powers, and in bracing up worn and unbalanced threshing machines, varying his labors by occasionally turning a gudgeon in a hand lathe. As an example of the pushing, pretentious ways this man has, the jury learned that he soon after left the allurements of the country machine shop, going up to Norristown, and, by representations as yet unknown to the jury, there obtained a job in a bar, plate, and nail mill. While in Norristown he claimed that he served an apprenticeship at the 'dentistry business,' this bold claim was not believed by many of the jury, and witnesses were examined and cross questioned, when it came out in evidence that the 'dentistry business' consisted in repairing the broken teeth of the gear wheels at night that had dropped off during the day; and he was reported to have said that if at any time he had any fears of being out of a job he went and looked in the wheel pits and was sure to find work. It was further reported that this man Fritz claimed to be very expert in setting 'single teeth,' but that he did not pretend to know much about 'plate work' at that time, but later on in his life it is said that he did some very creditable work in that line as well, for his Uncle Sam.

It is hardly worth while to further occupy the time of the Court in showing how preposterous it is for a man with such an education and experience to pretend to be an 'engineer' or a steel maker.

The second count of the indictment, is that the aforesaid John Fritz is a disturber of the peace.

Several years ago this man, now at the bar of this Court, came to the borough of Bethlehem, and, as it is supposed, for the purpose of attending a horse race, at least that was the ostensible object of his visit. The race course was a large, level field on the banks of the Lehigh, below the town, and away from any settlement. Sitting on the top rail of the fence, watching the boys trot their blooded steeds, the notion came into his head that the land about there would be a pretty good place on which to build a blast furnace, and perhaps a rolling mill or two. It is one of the known peculiarities of this man that when he gets a notion in his head all creation cannot change him, and there are witnesses here in court who can testify to this. So, having conceived the notion of covering this race course with furnaces and mills, the people who knew him best said it would be of no use opposing him, and that they might as well come down with the dust first as last, and they did, and he not only covered the race track with blast furnaces, rail mills, workshops, etc., but he covered the farms adjoining, and this can also be proved if necessary. By a careful search of the records, and by examining recently published documents, the Grand Jury learned that many years ago a body of peace-loving, mild and unassuming persons came from over the sea to find, if possible, in the New World a spot where they could live a quiet life and be assured of an undisturbed rest afterwards. They found, as they believed, such a spot in the wilderness, here on the banks of the Lehigh. Purchasing the land from the native Americans (upon terms not made public) they founded the peaceful hamlet long known as Bethlehem. It was the belief of many witnesses who appeared before the Grand Jury that, had it not been for the man now at the bar of this Court coming here, Bethlehem would have remained to this day the quiet place it was previously noted for being ; that the waving grain would still be bending to the summer breeze over lands now occupied by streets and lanes, or covered with comfortable and costly homes ; that no noises would have been heard other than the shrill cry of the blue jay, or the warning note of the kingfisher as he dropped from the swinging bough into the river beneath, the cooing of the turtle-dove in the wooded heights above, or the pleading song of the whippoorwill as the sun went down behind the western hills. That all this has been changed by the advent of this alleged engineer can be proven to the satisfaction of this Court. The rumbling of huge wheels, the throbbing pulsations of mighty blowing engines, the shriek of steam whistles, the angry roar of burdened engines, the clanging noise of falling beams and bars, the snorting puffs of the impetuous and bustling locomotives that ply to and fro over the clanking rails and rattling switches, have changed beyond all recognition the old-time peaceful hamlet of Bethlehem. Disturbing and distracting as all this noise and confusion now is, the prisoner has recently built and set in operation other and new steam hammers of

a size and weight hitherto unknown, whose descending blows make all the surrounding country to shiver and to shake; in short, the evidence has been so overwhelming against the prisoner as a disturber of the peace and quiet that once reigned along the banks of the Lehigh before he came, that the Grand Jury, mindful of their oaths, deemed it their duty to the commonwealth to present him to this Court, and to demand that he be tried by a jury of his peers, if such can be found."

(Signed) JOHN OLDBOY, *Foreman.*

SANITARY FEATURES OF SAN FRANCISCO.*

The following discussion on Engineer Manson's paper, published in our last issue, was shut out for want of space. It contains a good deal of local interest and value, warranting its republication at this time.

In the discussion, Dr. I. H. Stallard said:

"San Francisco, at the present moment, is in a kind of transition state, and important questions are likely to be submitted before long to the public. Mr. Manson has drawn particular attention to the foul condition of those districts which have been raised by large quantities of filth and garbage deposits, particularly in the southern portions of the City, and in various parts of the northern portion. I have had considerable experience in these matters. In Liverpool, England, large areas were formerly raised in the same way, but the authorities discovering the unwisdom of this process, have forbidden it by law. This was some twenty years ago. But there is a pollution of the soil in the City of San Francisco, to which I think your attention might very properly be directed. You are aware that we have a vast system of sewers, and that these sewers may be divided into those which come down the hillsides and those which lie in the level portions, that is, south of Market Street, and, we will say, east of Kearny. In a series of heavy rainstorms, more or less detritus is washed into the sewers, and where the descent is rapid it rushes to the bottom of the hill, where the current is slower, and generally, the sewers are larger; the consequence is that the detritus that has been washed from the upper levels settles in this lower part. In this way vast accumulations have taken place.

*Discussion before the Technical Society, and the San Francisco County Medical Society, May 19th, 1893. Reprinted by permission.

In the year 1886, I think it was, a large sewer was built on Channel Street. That sewer had accumulated last year, between five and six feet of deposit; it was nearly filled up with sand and silt. Vast sums have been spent on this sewer to keep it clear. For the last few months one hundred men have been employed in removing the detritus from this one sewer and the small branches which are tributary to it. The expense for this year has already reached $19.000. A thousand tons of gravel and a thousand tons of filth and silt have been taken out, and as much more remains. It was found last year that after a night's rain it raised the deposit two inches, and it would take an entire day to remove what had been deposited in one night. The debris accumulates first of all in the side sewers, and it takes a staff of men two weeks to clean a sewer two feet by five in one block. You can imagine what a labor you have in hand here, and the enormous expense.

The result of these accumulations is that the sewage, which comes down from above, not having a free and good escape, the gas from the sewer is injected in all directions into the subsoil under the houses. Experiments in Munich have shown that the air of the subsoil is capable of being conveyed a very considerable distance under ground. Therefore, where the surface of the street is sealed by bitumen or granite pavement, these gases escape in the basement of buildings, and find their way in various ways to the interior of the house, and are taken into the system by the occupants. Good plumbing is of great importance, but it does not meet this difficulty —in fact, the passageway for the pipes furnish a means for these poisonous gases to circulate. I have repeatedly found an odor of sewer gas in typhoid fever cases.

The question we have to meet is, how to convey the sewage away without a possibility of its being injected into the subsoil. Two things are necessary: First, the sewer must be so impervious that there is no chance of the sewage getting loose. No big brick sewer that you can make is impervious. The moment it becomes filled, it injects foul matter right and left through the soft brickwork. During the summer months there is nothing in the sewers except what is pumped in by the Spring Valley Water Co., and those sewers which are in the lower and flat portions of the City have such a sluggish current that sewage accumulates at the bottom, and the production of sewer gas is carried on to an enormous extent, and the consequence is that there is a pollution going on all during the summer time, which is even worse than it is in winter.

In the second place, the sewers must be so constructed, that they can readily be kept clear, and thus avoid any great accumulation of matter and the stopping of the sewage.

Now, I think this is a most important question. I have limited my observations to this because it is a part of the subject that Mr. Manson has treated. He has spoken of the foul condition of the subsoil upon which many of our houses are and will be built, and I agree with every word he has said upon that subject. But I hold that the contamination of the subsoil from the sewers is vastly greater than that which comes from the deposit of garbage, because that, after all, is a local affair, but this other is general throughout all parts of the City where the sewers are nearly all approximately level.

I am glad that this step has been taken, and I hope this will not be the last meeting of this kind. We ought to have a general sanitary association of the citizens of San Francisco to promote the teaching of sanitation among the people, and to show them the frightful amount of disease and death which comes from neglect in this particular. In a lecture delivered in this City last year, I endeavored to show that at least four thousand deaths a year are unnecessary, because of bad sanitary conditions. I proved that by a comparison with other cities, and also by a reference to the nature of the diseases from which our citizens died."

E. J. MOLERA.—"I think it would be well to have some members from both the Medical and Technical Societies appointed to outline a plan for improving the sanitary conditions of San Francisco, not only as to sewerage, but also as to the building of houses so that they will become healthful. The sources of water supply should be considered likewise. Mr. Manson has pointed out the dangers of pollution from the water supply. Let that be thoroughly considered. I think if this matter were presented to the public, there would be no trouble in passing laws necessary for the improvement of the health of our City."

DR. BUCKLEY.—"I came here this evening intending to be a silent listener. I do not know that I have anything to urge in addition to what has already been said. I think one great trouble with our sewers is their defective construction to begin with.

I will mention an instance or two in my practice indicating the necessity of a pure water supply. It is a very well known fact that impure water is a great source of disease. Some years ago I was called to attend a number of boys who were sick at Old St. Mary's College. They were all down with a fever; it was not very pro-

nounced at first, but I considered it typhoid. I attempted to find out the source from which they were contaminated, and had an examination made of the water tank through which the water supply of the college passed. The tank stood on a platform by itself and was about fifty feet above ground. On investigation a dead rat was found in this tank, which caused all the poisoning of these boys. Fortunately none of them died, but about seventy-five suffered from fever, and before they recovered were in a very dangerous condition.

At a later period I was called down to San Mateo County to a farmhouse, and there I saw the lowest and worst form of fever I ever witnessed in my life. Three grown children had been buried in the garden within a week, and the farmer's wife and three more children were nearly at death's door. I investigated the source of water supply, and found that that idiotic man had a sink from his stable absolutely draining into his well, from which they drew their drinking water. This simply emphasizes the necessity of pure water, a fact which Mr. Manson has so ably dwelt upon already."

DR. MCNUTT.—"Mr. Manson has urged the necessity for a pure water supply. It is pretty well understood now that a large number of diseases are carried in the water, such as typhoid fever, cholera and many others. I suppose that our sewer system is about as bad as it can be. I do not propose to go into a description of a complete sewer system, because there is a great deal of difference of opinion about sewers. Some think we should have sewers for carrying off waste water only, and separate sewers for carrying the debris. That, of course, is a matter for engineers to solve. I know that at some future time we will have the matter regulated.

There is a great deal more to deal with in the sanitation of dwellings than the mere sewerage and the water supply. Dr. Stallard has pointed out how foul gases permeate the houses. Oftentimes sewer pipes, made of porous cement, are run under the house, which allows the gas to escape into the cellar and basement, and contaminate the entire building; and this without any breaking of the sewers whatever.

The washstands in many houses seem to be about as badly regulated as possible, and the tanks do not receive much attention. Then again the system of bathrooms and water closets in the middle of the house is a mistake; these could be placed outside, or to one side of the house, where much less injury would be done from gas that may escape through them. Washstands and water closets should be placed where they can be well ventilated.

Dr. Stallard strikes the keynote when he says you must educate the people to realize the importance of these matters; they do not seem to realize the great importance of good sewers, pure water, or a system of ventilation for their houses. I think it would be well to teach the growing children in our public schools this subject; and when they grow up and become our Board of Supervisors, and our people in authority, they will probably make some progress in this direction. But until then, it seems rather up hill work to get the citizens to take hold of sanitary improvements as they should."

DR. STALLARD.—"I would suggest that a Committee be formed from the two Societies, and that this Committee inaugurate meetings of this kind, and take up these questions in a regular order, limiting the discussion to certain particular points. The subjects might be, for instance, something like this: The relation of the sewer gases, or the water supply, to the propagation of any disease; what the ultimate disposal of the sewerage of the City shall be; what shall the sewers convey; what limitations shall be put upon the use of the sewers, etc. I think this would do considerable towards enlightening the public on these matters.

I wish to make another remark upon the question of malaria and water. One of the most remarkable examples of the effects of water used from deep wells has been shown on the large ranches of Mr. Haggin, in the neighborhood of Bakersfield, Kern County. In former times that locality had the most malignant forms of malaria; scarcely a person who was not seized with it in the most serious manner, and it was quite dangerous to life. Mr. Haggin has, I think, eighteen ranches there, and on every one artesian wells have been sunk; since the use of that artesian water the malaria has almost disappeared. It has become so mild that there is really no serious consequences to the inhabitants. I think that is as strong a confirmation as anything can be of the correctness of Mr. Manson's conclusions on this subject."

MR. MANSON.—"Since this paper was read and discussed, the City of Oakland has been subjected to a remarkable outbreak of typhoid fever. So far as can be ascertained the disease was originated by the use of contaminated milk from a dairy using filthy water for watering the milch cows, washing cans, and probably for diluting the milk. The disease was also aggravated and extended by foul and defective sewers, thus furnishing a sad and costly object lesson near at home, and in a city which should be nearly—if not absolutely—free of filth diseases."

A NEW METHOD OF FIRING STEAM BOILERS.

We have a good many times predicted that common methods of burning fuel would soon give way to some improvement, looking to an increased economy and avoidance of smoke. Among the elements of steam power, the use of steam, its distribution and economy in engines, also the construction of engines and their adaptation, one can see at this day limitations that are near at hand and final. They may also see in the amazing diversity of boiler arrangement and adaptation some signs of an approaching limit or standard for the effect of heating surface.

To these things have been directed the best engineering and mechanical talent of all countries, but in methods of combustion these remarks will not apply. It is true that down-draught, bottom feeding, automatic stokers, gas producing, and an endless array of air ducts, steam jets, patent grates, and so on, have appeared in late years, but in all these things there is no promise, or at least no corresponding promise, of complete combustion.

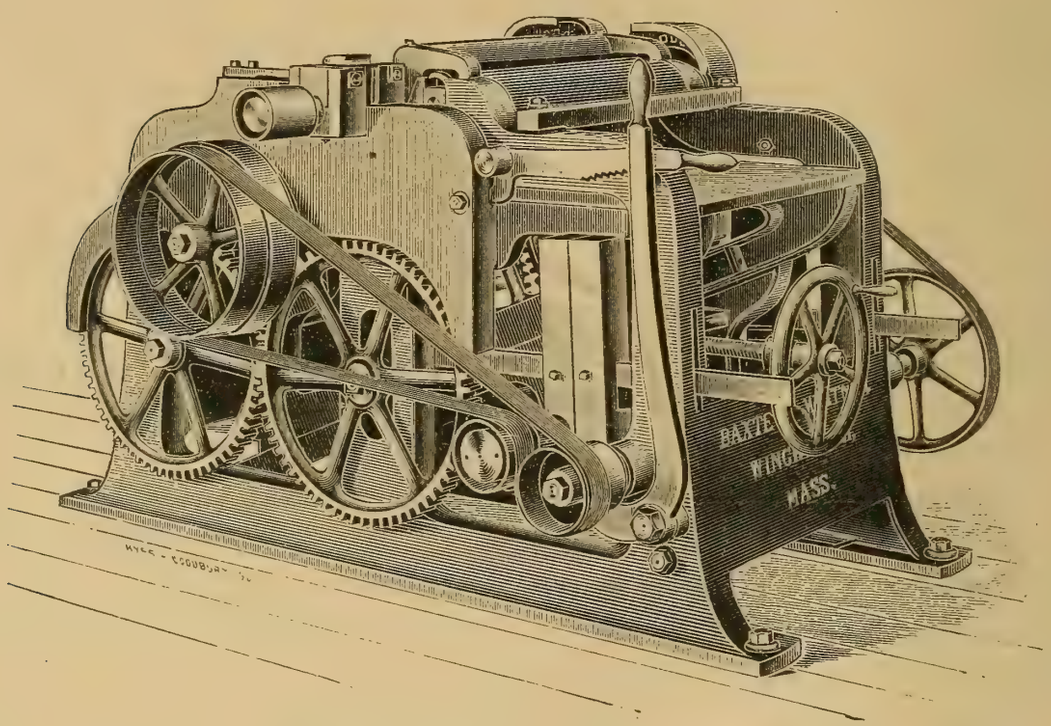
The chemical phenomena of combustion are well understood, and the lack is in application or methods, and it is in these the next step may be looked for in steam engine economy. It is here the greater losses take place, losses that seem avoidable up to the point of complete convection and radiation at least.

These remarks have been suggested by an invention of Mr. Thomas Henderson, of Liverpool, England, who proposes, or indeed has applied to a large number of steamers, what may be called "active grates," that is, grate bars that have a continuous motion that in connection with their inclination, causes a continuous crawling of the fuel from the front to the rear end of the bars, where slag or other non-combustible residium is discharged automatically and drawn off beneath and clear of the fires.

By this expedient there is obtained a great deal more than will at first be supposed. The fresh fuel being fed in front, the heavy gases of combustion pass over the incandescent part, the same as in down-draught or bottom feeding; the grates are kept clean, and air admission is free all over the grates; clinkers and waste matter are dumped automatically, beyond the fires, and are drawn out beneath them. The amount of fuel that can be burned, and consequently the capacity of a steam boiler, is much increased, the inventor claims

20 per cent.; and above all, perhaps, is the fact that with these active grates there is no cleaning of fires required.

The *City of New York* is fitted with this system of grates, also a list of thirty or more vessels that need not be named, so the method has passed beyond the experimental stage. We see in this invention a new system of firing and combustion, more important than anything presented for some years past.



A SPECIAL PLANING MACHINE.

B. D. WHITNEY, WINCHENDON, MASS.

In our last number was mentioned a planing machine furnished by Mr. B. D. Whitney, of Winchendon, Mass., for the U. S. Patent Office at Washington. No sectional drawing or description of the machine has been sent, so that aside from the peculiar uses of the machine, which constitutes a part of the equipment in a constructive department maintained by the Bureau, we can only point out the bed or platen with the bottom feed rollers and their gearing rests upon an angular slide or wedge, moved by the central hand wheel on the right, so that a firm support is gained for the whole length of the platen. This method has never been adopted by any other maker. The machine is fitted with unusual care in all parts, and a great credit to accurate workmanship in this country.

BELT LACING.

If some examples of belt joining recently examined are not the final evolution of that much-written-of "art," the results have been misstated. In the Starr Mills, at Vallejo, Cal., is a heavy main belt 48 inches wide, bending sharply over pulleys two ways, or each way, that has gone on for a year or more having its ends joined by an insignificant lacing of copper wire.

There is some mystery in the matter, or else, what is more likely, a great mistake in the supposed causes that destroy belt fastenings. Since seeing this and some other examples of the same kind, we have come to the conclusion that want of flexure in the joint has been the main difficulty in maintaining belt fastenings.

In this wire system the stitches are close to the edge, not more than a thickness of the belt from the ends, and there is no sign whatever of the wires cutting through the leather. The large belt above mentioned is nearly half an inch in thickness, and the wire used about No. 14.

The work contrasted with a joint made with leather thongs or wire hooks is incomparably neater, and as nothing projects beyond the faces of the belt, and there is no sign or indication of the joint, when it passes over the metal pulleys, indeed no evidence of any kind that there is a joint in the belt.

Since examining the above case we have been informed by Mr. Macdonald, the engineer of the California Electric Light Works, that his company has, for some time past, had the same method in use with like results, so there can be no question of endurance.

METHODS OF BORING.

In our able contemporary, the *American Machinist*, there appeared recently a communication on "The Advantages of a Chucking Department," which, we presume, means one for boring holes or a department for boring.

While the writer's address is not given, it is evident that he hails from New England, where "chucking" is an almost universal method of boring holes, that is boring on lathes by revolving the work. In some cases this method is necessary or best, but the less of it the better. If the writer had learned his trade in Philadelphia

his views of "chucking" would be quite different, because boring is done there wherever practicable, and that means nearly all of it on boring machines made for that purpose and with bars supported at each end of all pervious holes.

This is not only true of Philadelphia practice, but of good practice nearly everywhere, and lathe "chucking" is the exception in well regulated works.

The reasons are that in boring on lathes it is common to depend upon the rigidity of projecting tools or bars that are weak in comparison with proper boring bars supported close to the work at both sides. This method, we know, is not exceptional in New England even, a good deal of boring being done on machines for that purpose, but the "chucking lathe" is seen almost everywhere in the New England States the same as it was in other places twenty-five years ago.

In general terms, boring should not be done on lathes when avoidable, not only because of less perfect work, but also because of the time and cost. Theoretically, the truest work can be done with a non-feeding bar, the work being traversed on a carriage, but practically this is not true, and besides, when done on a lathe, does not come within the term "chucking," which means mounting the work on the spindle of a lathe and boring with stationary tools or tools not revolving, commonly with flat drills and rosebits.

TECHNICAL SOCIETY OF THE PACIFIC COAST.

This association held their regular meeting on the 7th of last month. The following new members were elected, and two applications for membership were received.

For Members:

Richard Gernon, County Surveyor.....Tehama Co., Cal.
Frank P. Medina, Electrical Engineer.....San Francisco, Cal.

Junior Member:

Wm. W. Fogg, Civil Engineer.....Oakland, Cal.

Associate:

Otto Putzker.....Berkeley, Cal.

Mr. N. J. Manson, of this City, read an essay on Inter-Oceanic Ship-Canal Communication by the American Isthmus.

This subject is one to which Mr. Manson has given a great deal of attention, and has been presented by him in various writings in an earnest and vigorous manner, discussing the legal, economic, physical and political phases of it in a manner not attempted by anyone else in this country.

The printed matter, public documents, and speeches in Congress have for the most part, or indeed almost wholly, been in the interest of promotion, and Mr. Manson's views might be classed in the same way, but from a different standpoint, namely: that the U. S. Government should itself construct and own the canal, free from private or company interests of any kind. The justice and fairness of this no one can dispute, and when we consider the facts pertaining to all, or nearly all, Government-aided enterprises in this country, there is more than expediency in favor of what is recommended.

Of the Isthmus, he says:

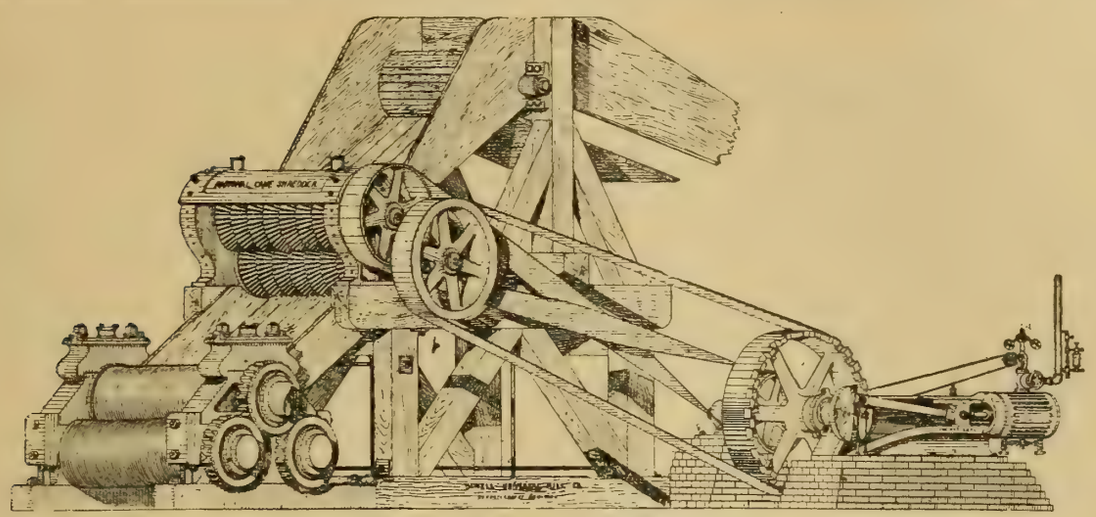
"The American Isthmus is for nearly its whole extent a ridge of the Cordilleras. From Tehuantepec, where it joins the expanse of North America, to the Gulf of Darien where it joins South America, it is in length about 1,230 miles. Its width is out of all proportion to its length. It is more essentially an isthmus than any other narrow neck of land on the globe. If we will compare the mean of the widths of the Isthmus, at Tehuantepec, 143 miles; at Honduras, 161 miles; at Nicaragua, 169 miles; at Panama, 47½ miles; at San Blas, 30 miles, they will give for the breadth of the isthmus about one eleventh of its length. Its lowest elevations above sea level, at possible points of inter-oceanic transit, are at Tehuantepec, 754 feet; at Honduras, 2,000 to 3,000 feet; at Nicaragua, 153 feet; at Panama, 287 feet; at San Blas, 1,142 feet; at Caledonia, 1,003 feet; at the Truando-Atrato, 950 feet; at the Napipi Atrato, 778 feet; at the Tuyra-Peranchita, 808 feet. The last five routes are all so mountainous and elevated as to require tunneling from six to ten miles in length. The entire Isthmus has been called an immense causeway, separating the seas while uniting the continents. It is worthy of thoughtful consideration that while the African Isthmus, Suez, is but the center of the Old Continent, the American Isthmus is the center of the oceans."

What may be called the principal point in the paper is the danger of permitting corporate control over waterways of any kind. It is certainly a policy of this Government that waterways should be free, and are free, in so far as all naturally navigable waters of the country. These the Government protects and keeps in order. Artificial waterways for general commerce should be the same, made, owned and controlled by the Government, or by the whole people, which the term "Government" means in this case.

The following table, showing the remarkable increase of traffic in the Suez Canal, is given in Mr. Manson's paper :

Year.	No. of Ships.	Net Tonnage.	Receipts.
1870	486	436,609	$ 1,031,865
1871	765	761,467	1,798,746
1872	1,082	1,160,743	3,281,513
1873	1,173	1,367,767	4,579,465
1874	1,264	1,631,650	4,971,476
1875	1,494	2,009,984	5,777,260
1876	1,457	2,006,771	5,994,599
1877	1,663	2,355,447	6,554,868
1878	1,593	2,269,678	6,219,645
1879	1,477	2,263,332	5,937,212
1880	2,026	3,057,421	8,364,179
1881	2,727	4,136,779	10,935,238
1882	3,198	5,074,808	12,681,918
1883	3,307	5,775,861	13,702,413
*1884	3,284	5,823,977	12,494,002
1885	3,624	6,289,788	12,320,819
1886	3,100	5,728,319	11,587,707
1887	3,137	5,901,030	11,484,582
1888	3,440	6,606,570	12,864,893
1889	3,425	6,724,021	13,268,038
1890	3,389	6,824,390	12,994,799
1891	4,207	8,552,590	15,503,874

*From the year 1884 to the year 1891, inclusive, the gross tonnage only was given by the above authorities. The gross tonnage was reduced to net tonnage by taking 70 per cent. of the gross tonnage, which Mullhall states to be the proper reduction to be applied. From 1884 to 1891 the net tonnage is only thus approximately correct. The net tonnage for the preceding years is absolutely correct.



CANE SHREDDING AND PRESSING MACHINE.

THE NEWELL UNIVERSAL MILL CO., NEW YORK.

Mr. W. A. Allen, of 132 Market Street, of this City, who proposes to introduce the invention in the Hawaiian Islands, sends us the illustration above representing a shredding attachment for cane mills, that seems to be a positive advance in this class of machinery.

Some familiarity in former times with cane grinding on the Louisiana sugar coast enables us to form some estimate of the advantages gained by shredding or disintegrating the cane stalks before they enter the pressing rollers.

In the old manner of operating. the amount of power consumed was much in excess of what inference would allow, due to the fact that the pressure over the whole face of the rolls was what was required by the extreme resistance of the hardest and largest stalks ; not only this, the feed was irregular, the cane being fed on the belts by hand, by a number of people standing along each side.

In the present case there is mounted above the expressing rollers, a pair of shredding cylinders, as seen in the drawing, driven by belts and armed with serrated discs or cutters that tear up the cane into a coarse pulp, so it is fed in a uniform stratum to the rolls.

The pressure required is much less, and the bagasse is dryer, from 5 to 10 per cent. more of the juice being extracted, while the amount that can be passed through the rolls is increased from 25 to 40 per cent. The machinery is already in wide use in this and other sugar producing countries, and as mentioned at the beginning, Mr. Allen proposes the introduction of these shredders in the Hawaiian mills, where, as we are informed, the cane is at present fed directly to the rollers, as was done in Louisiana and Cuba before the present system was introduced.

THE UNITED STATES PATENT OFFICE.

We have received the following communication from the "American Association of Inventors and Manufacturers," a large and influential organization, among the officers of which appears the names of the Hon. Benjamin Butterworth, formerly Commissioner of Patents; Chas. F. Brush, of Cleveland, Ohio; Prof. Robert H. Thurston, of Cornell University, and many other prominent and responsible men of national reputation. The subject of the communication needs no comment, it relates to an anomaly, if not a disgrace.

"DEAR SIR:—Will you not take a personal interest in urging some legislation for the benefit of the Patent Office? That office is in more pressing need of additional room than can easily be described.

The entire building, substantially as it now exists, was planned about 1836 as a Patent Office (see Act of July 4, 1836, 5 Statutes at Large, 115). That was thirteen years before the Interior Department was created. Now the examiners and their clerks, with their desks, are so crowded in the rooms that it is with difficulty they move about. They are occupying a great number of basement rooms, never intended to be used as offices. The halls are lined on both sides with unsightly cases of papers. This state of things interferes with the health of the force, and it retards their work most materially. The General Land Office is occupying a great number of rooms in the Patent Office building, and if the Land Office were put into other quarters it would give the Patent Office force much of the room it needs. In the last Congress some good friends of the Patent Office procured an appropriation of $16,000 to rent other quarters for the General Land Office, but the substance of it remains unexpended and the substance of the Land Office still remains in the Patent Office. Over $350,000 of moneys taken directly from patent funds have been incorporated in the Patent Office building, and the Treasury now has $3,947,000 of patent funds unapplied in its custody, easily more than enough to pay for the entire Patent Office building, and there is no prospect that this money will ever be applied otherwise for the benefit of inventors.

Again, the Patent Office urgently needs an increase of force, not only to bring the work on applications for patents up to date, and keep it there, but to inaugurate and carry on certain classes of work, the performance of which is absolutely necessary to the future needs of the patent system. Will you not kindly write a personal letter to your two Senators and Representatives in Congress urging on them the legislation which shall give the Patent Office that room in its own building which it so much needs, and such an addition to its force as will enable it to keep up with its current work, and provide for the needs of the immediate future? It is earnestly desired

and asked of you that you shall at once write such letters to your senators and congressmen, urging the passage of legislation as to room in the Patent Office, and as to increase of Patent Office force. And will you report to us that you have thus written ?"

Very respectfully yours,

J. E. WATKINS, Sec'y.

ENGINEERING CONGRESS.

SECTION B.

At the meeting of the mechanical engineers, in Chicago, August 1st to 5th, the following papers will be read by the authors, whose names are annexed :

TUESDAY, AUGUST 1, 10 A. M., ART PALACE.

Tests of Pardue University Locomotive.....W. F. M. Goss.
Locomotives Operated by Total Adhesion.....A. Mallet
Compound Locomotives.....A. von Buries.
Experience in Working of Rack-Railways .....A. Schneider.

WEDNESDAY, AUGUST 2, 10 A. M., ART PALACE.

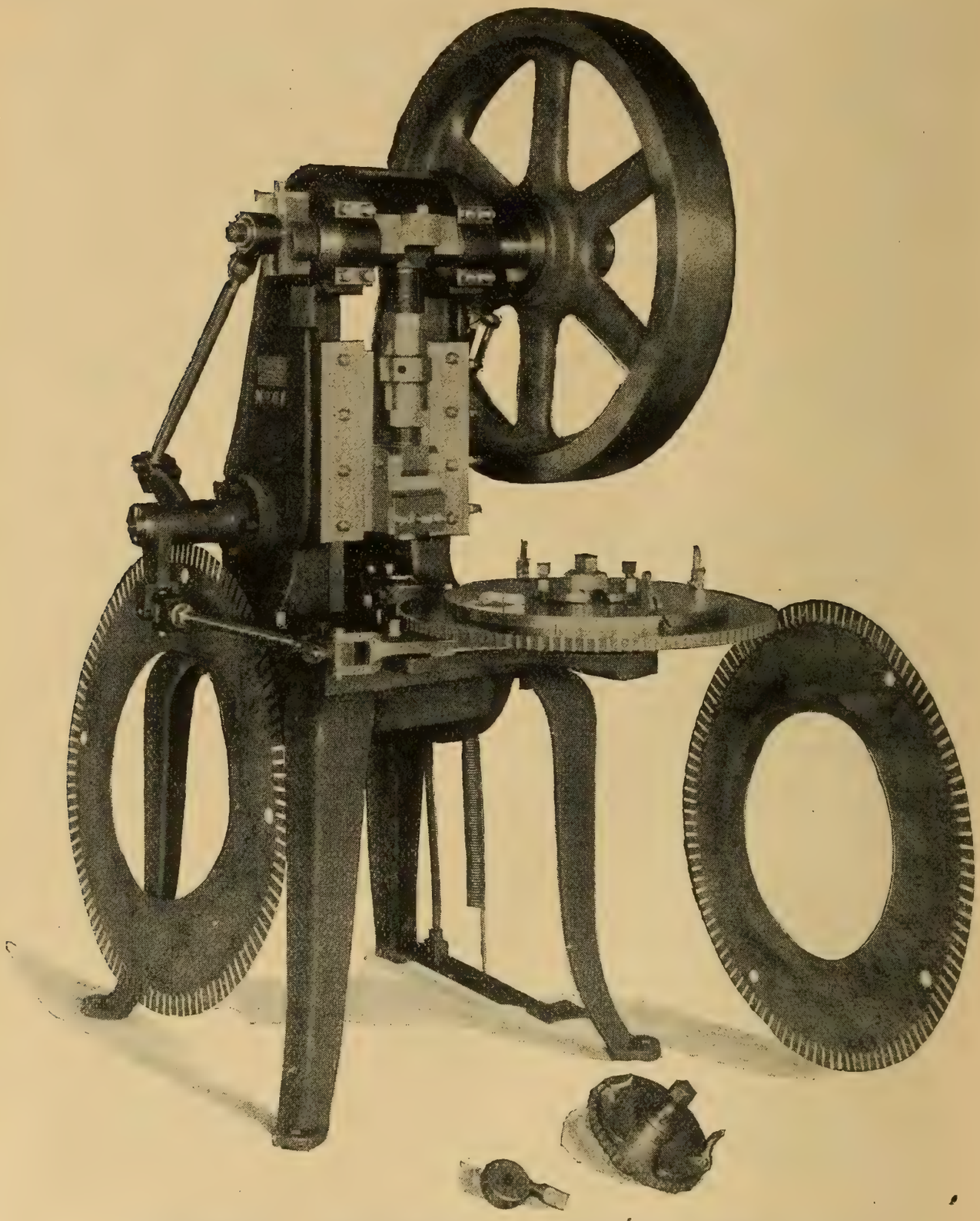
The Working of Centrifugal Machinery.....Gust. Herrmann.
The Removal of Dust in Workshops.....R. Kohfal.
The Taxameter or Fare Indicator.....C. Pieper.
Apparatus for Metering Steam.....Franz Seiler.
Improvements in the Art of Cable Making.....Emil Guilleaume.
Measuring of Water and the Schinzel Water Meter.....F. Lux.

THURSDAY, AUGUST 3, 10 A. M., ART PALACE.

Contribution to the Theory of the Steam Engine, V. Develshauvers Lery.
Limitation of Engine Speed.....C. T. Porter.
Compression as a Factor in Steam Engineering Governing,
F. H. Ball and D. S. Jacobus.
Performance of a Triple Expansion Pumping Engine,
With and Without Jackets.....J. E. Denton.
Performance of Street Railway Power Plants,
Wm. A. Pike and T. W. Hugo.
An Evaporative Surface Condenser.....Jas. H. Fitts.
A Coal Calorimeter.....Geo. H. Barrus.
Anhydrous Ammonia Gas as a Motive Power.....T. W. M. Draper.

FRIDAY, AUGUST 4, 10 A. M., ART PALACE.

A General Engineering Classification and Index.....Wm. L. Chase.
Notes on the Drainage Machinery of the Netherlands.....A. Huet.
The Refrigerating Machine of Today.....C. Linde.
The Interchangeable System of Manufacture.....W. F. Durfee.
Rod-Rolling Mills and their Development in America..F. H. Daniels.
Technical Education in the United States.....R. H. Thurston.
Haulage by Horses.....Thos. H. Brigg.



SPECIAL AUTOMATIC PUNCHING PRESS.

THE E. W. BLISS CO., BROOKLYN, NEW YORK.

The machine above shown is especially designed for preparing notched plates for armature discs, such as are employed in electric generators or motors, and is provided with automatic apparatus for

cutting a predetermined number of notches in the circumference of such plates.

The machine is started by means of the treadle shown on the right, and continues automatically until a plate is finished, the treadle is then released and another plate inserted. The machine shown will receive and prepare plates from 10 to 34 inches in diameter, and weighs only 1,700 pounds. They are in use by a number of the electric companies, and have much reduced the expense of preparing these serrated plates.

There are no class of machines in metal work that perform so much and so rapidly as punches and others having direct action. It is common to think of shaping iron as a slow and expensive process, and this is true of all cutting processes, but casting, forging, and punching are more rapidly performed than in the case of any other kind of hard or non-plastic material. Among such processes are cold pressing and punching, requiring, it is true, massive and accurately made machines, but performed at a rate that is marvelous, when the implements are strong enough and properly designed. The amount of "hot treatment," as in forging by hammers and drop presses is all the time giving way to cold processes, wherever the metal is not required to "flow." The construction of machines for punching and shearing, requiring a force of 20 to 25 tons for each square inch of cut surface, calls for a careful study of strains and material.

TIN PLATE ONCE MORE.

The *Iron Age* is fearful that Secretary Hamlin will interfere with the "tin plate report of the special agent Mr. Ayer," and insinuates that this is possible. There is no fear of this, the danger is all the other way. This whole tin-plate business has been a scandalous imposition on the American people, yet all who criticise it are set down as "enemies to tin-plate manufacture." There are no enemies to tin-plate or any other manufacture, but there are enemies to tin-plate tax and tin-plate "humbug," of which we have had quite enough. The duty of 2.2 cents a pound was not put in force for nine months after the passage of the Act, so as to permit the promoters of the scheme to import all the tin plates that could be found in Europe, to be sold at enhanced prices, because of the spasmodic demand and by reason of the higher duty. Then to

retain this duty the returns of American made tin plate were permitted to include foreign-made plates dipped in imported tin, a thing never contemplated in the law.

The report needs watching there is no doubt, but not for reasons given in the *Iron Age*. The main fear is further exposure of this tin-plate "deal," which is bad enough now, and we think the Secretary of the Treasury is fully warranted in holding the report to verify the statistics that are set forth in that document.

We spent some little time and money two years ago by having friends at the East investigate some of these tin-plate works, and unless circumstances have altered since then the Department report will bear a large amount of investigation and holding also. What the country wants is the truth. This whole tin-plate matter has from the beginning dealt very little with that commodity, and it is time some should appear.

On this Coast, where we consume 350,000 boxes a year, tin plate is what may be called a vital element in business, and a tax of 2.2 cents a pound with the incidental increase in price due to disturbing the market is a grievous matter. The whole amount imported is from 20 to 25 millions of dollars worth yearly. In 1891 nearly $26,000,000, was purchased, and afterwards sold for $10,000,000 more, which was mainly tax and inflation.

We have laid away copies of the various journals, prominent among them the *Iron Age*, that labored to convince the American people by every kind of artifice that this tax was to develop tin mining and manufacture in this country, and that our tin mines were successful, and would soon furnish enough to supply the whole country, and all this was based on a beggarly amount of 120 tons procured in California at an expenditure of $450,000 for the mine property and $350,000 for mining the 120 tons of tin that cost nearly $1.50 a pound, and 10 tons in Dakota that probably cost $5.00 a pound.

Every honest person will deplore this failure, and the losses which fell mainly on foreign investors, but what are we to think of those who, down to the closing of these mines, continued to delude people with false statements respecting them, and who can wonder that the Secretary of the Treasury thinks it expedient to scan the work of men who were concerned in such a questionable kind of business.

A proper course would be to put Mr. Ayer's report away, and send out a commission of capable and honest men to sift out the

truth, and let the country know what has been done, or is likely to be done, that demands a subsidy of immense proportions, paid mainly by the poor, who are the main consumers of tin plate.

AN EXAMPLE OF HIGH-SPEED PUMPING.

The subject of high piston speed or increased duty for water pumps, which occupied some of our space last month, has brought out some facts quite creditable to practice on this Coast. This far the following example is ahead, with a pump of 17 inches bore, moving at 450 to 470 feet per minute, as will appear from the following communication from the President of the Fulton Engineering and Shipbuilding Works of this City.

To the Editor "Industry."

Sir :— In speaking of high-speed pumps a few days ago I mentioned a case in which I had been consulted, which is that of the Yuma Water and Light Co., H. W. Blaisdell, Manager.

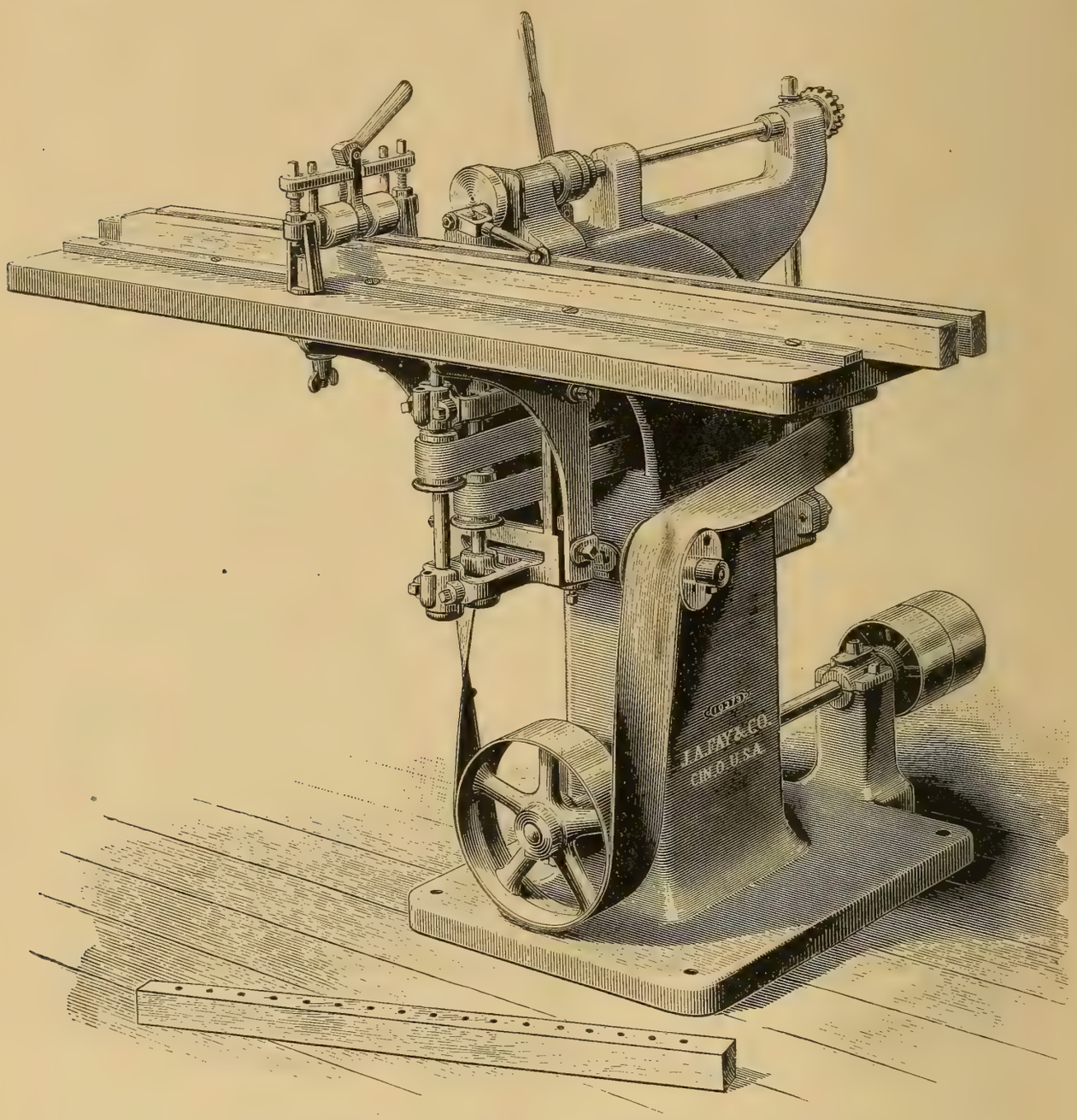
About a year ago Mr. Blaisdell wrote me stating that he had an engine 18 inches in diameter, 42 inches stroke, and that he wished to use it to operate a pump to raise water for irrigation, etc. I recommended to him in making it to drive direct from the engine, by extending the piston rod through the backhead with large valve area proportionate to the *quantity* of water to be delivered. This he did, making the pump 17 inches in diameter, with the same stroke of the engine, viz. 42 inches.

In a letter received from him he tells me that this pump is now raising 7 million gallons of water 90 feet high in 24 hours, using 7½ cords of Mesquite wood, the engine making 64 revolutions, or practically 450 feet per minute of piston speed for the pump. The delivery pipe is 26 inches diameter, and 2¼ miles long, the suction is 24 inches diameter. The boiler pressure from 80 to 100 pounds per inch. The pump valve area is *200 per cent.* of the plunger area. He states also that the pump runs smoothly at this speed.

The important features in regard to the construction of the pump is the large valve area, delivering the water into a large pipe at a little less than three feet velocity per second, enabling the pump piston to travel at a high speed. Mr. Blaisdell also states that he has made 67 revolutions, or 467 feet per minute piston speed, and that there is no trouble in running it from 60 to 67. He uses a condenser, obtaining 20 inches vacuum. It would have been better if the delivery pipe had been still larger, so as to bring the velocity of flow under 2 feet per second. I am, yours truly,

James Spiers, *President.*

Fulton Engineering and Shipbuilding Works.



AUTOMATIC WOOD BORING MACHINE.

THE J. A. FAY CO., CINCINNATI, OHIO.

The machine shown above is for boring at regular spaces the side rails or stiles of window blinds to receive the tenons of the rolling bars or slats, and is a good example of the ingenious adaptation of modern wood working machines.

Two pieces, or the stiles for one blind, are bored at the same time. The forward feed or spacing is done by the adjustable crank seen at the top, which can be set for any required pitch. At each forward movement the two boring spindles beneath are fed upward and recede by automatic gearing, the chips falling downward, clear of

the work. The work is thus done with precision and at a rapid rate, with a comparatively cheap and simple machine that some years ago would have been quite unthought of. A result of these special machines has been a wondrous cheapening of house joiner work; an interest that affects everyone in the land. All must own or hire house room of some kind, and every good machine reduces the price of this necessity. The cost of rolling blinds, for example, has been reduced to one half of what it was twenty years ago, consequently they are within reach of twice as many people.

TANGENT GEARING.

Designs for worm elevator gearing are often illustrated and described in the eastern journals, and a large share of hoisting gearing is made on this method, the worm wheels being in most cases smaller in diameter than the winding drums. It is true that by very careful workmanship and the best of material such gearing can be made that will perform under heavy strain upon the teeth, and is barely true. Inferentially one would suppose that any kind of gearing, where the total strain falls on one tooth and the contact a mere line or point and the action a sliding one, such gearing would wear out at once, and it would, were it not that the surfaces are flooded with oil.

Our contention is, that there is no good reason for employing worm or tangent gearing for elevators, or in any case where there is heavy strain. It is the most compact among devices for diminishing motion, but is nearly impractical for increasing motion; and in this lies a significant fact.

People sometimes recommend worm gearing for elevators because it is safe and will not "run down," that is the friction is so great that the cage cannot become the driver, so to speak. This being true of "running down," it is equally true of "running up," and the loss in friction is thus indicated, amounting in the best constructed wheels to twenty per cent. or more.

In designing and making machinery it is a tolerably good rule to not employ tangent gearing in any case or for any purpose whatever. There are places where it is convenient, and perhaps expedient, but not many. On this Coast, where winding gearing of all kinds is an extensive class of machinery, one scarcely ever meets with tangent gearing. It is not a favorite method, and considering the class of work done and its purposes, we are quite as well off without it.

WASTED MATERIAL.

Mr. Robert Caird, a veteran ship builder in Scotland, has been figuring out how much dead weight of material is carried in vessels by reason of "bad workmanship," that is, the amount of iron and steel that has to be added because of bad distribution and fastening. Mr. Caird says:

"Lloyd's Registry practically determines the scantlings to which vessels are built in Great Britain, and in doing this a factor of safety is fixed by the committee in excess of the theoretical strength of the materials of the structure to resist any strains that may occur. This factor is the result of experience of the heterogenity of the structural material and defects of workmanship. In this it is not even the average that rules, but the worst that the society will pass." * * *

"Mr. Caird stated that he had made a calculation which showed that in the mercantile marine of Great Britain there is invested over $25,000,000 in excess iron and steel employed in the construction of steamers, an excess which is required and is carried about simply as an allowance for bad workmanship. The calculation showed further that over $1,000,000 worth of coal is burned annually in propelling this surplus material, which should be quite unnecessary."

In this statement Mr. Caird was no doubt in an excusable way advertising his own business. This can very well be afforded in as much as he has introduced a line of inquiry applicable to a good many other things besides steam ships, and possibly in an equal degree to structures of every kind. Perfection is not attainable, and the factors of safety imposed will always embrace a margin for bad workmanship. As Mr. Cleveland once said: "It is not a theory, but a condition that is to be dealt with," and there is no practical means of improvement outside of commercial incentives.

A PEACE ARMY AND NAVY.

The *Nation* in reviewing the late speech of Captain Mahan of the U. S. Navy, who wants war steamers to keep peace with, says:

"To the naval and military eye in every country the world is full of national enemies who cannot be too closely watched. The immense armaments of Europe could not be maintained if the army and navy had not won over a large and powerful section of the public to their way of thinking. We must also admit that great

fleets and armies could not be maintained in a state of efficiency if the soldiers and sailors did not believe that war was always imminent, and that they were literally protecting seriously threatened national interests. It is almost as necessary that a soldier or sailor should see a fair prospect of a fight in the near future as that he should welcome the fight when it comes. But woe to the nations which share his martial ardor and bellicose expectations. The history of Rome, France, Sweden, and even England, illustrates only too horribly the results of allowing military opinion to get the better of civil opinion in the regulation of foreign relations. The larger the armament grows the more need there is on the part of statesmen, of a cool and critical view of the alarms and enthusiasms of the military men."

The hallucination, for it is nothing more, that other nations want to insult, trample upon and conquer this or any other country, is one of those weak inventions that must go to show how unaccountable are the methods of reasoning, even among the educated. The assumption of peace coming from armies and navies is not true, and in the nature of things cannot be. The Chilean affair of two years ago, which Captain Mahan cites, is bad evidence, as at no time nor in any manner did the Chileans mention such a thing as a foreign war with any country.

We have trusted this far to education and its ethics to restrain these belligerent men who, like the German Emperor, want to "conquer peace." Some more positive means may be required to suppress them.

Some recent figuring on the cost of power conveyed by water shows that the greater the pressure the cheaper in proportion becomes the expense or cost. For example, water at 100 pounds pressure costs about double what water at 700 pounds pressure will, estimating in both cases by the energy or work the water will perform. This is a curious result, and an interesting problem. The water and the pressure upon it are different elements. The amount consumed for a given duty is inversely as the pressure, so that if the cost of water is much there is considerable gain in this way, but it is obvious that the greater pressure the cheaper that becomes, because the volume being the same increment of cost will not follow increment of pressure. The pumping machinery will have the same capacity in power, but require to be smaller and stronger. The power consumed will, of course, be as the pressure. Pipe friction is as the volume irrespective of pressure and velocity.

ELECTRICITY.

NOTES.

It is reported that by means of perforated or skeleton forms filled with peroxide of lead, interposed between plates of solid lead, storage batteries have been increased in capacity from 3.52 to 25 ampere hours. An inventor, M. Tommasi, employs forms or skeletons of celluloid or ebonite to hold the active material, and the wonder is that electricians have not sooner abandoned the idea of mechanical adhesion on the electrodes, and confined the peroxide between plates so the whole battery is solid, and no warping of the plates possible. The idea is not new in this country, and is, no doubt, capable of extension and improvement. The main difficulty is, we imagine, that storage batteries have this far been devised in laboratories, and when mechanics get at them there will be added a good deal in constructive features which electricians cannot be expected to supply.

Electric Power mentions a remarkable apparatus by Professor Thomson, to be shown at the Chicago exhibition. It is to produce a spark three to four feet long, and as stated will have at its terminals an estimated difference of potential of one million volts. This will far exceed the Telsa experiments and be the most remarkable exhibit of an electrical kind that could be devised, because it conveys to the public, and indeed to anybody, an idea of tangibility —something that can be seen or even heard. Insulation of such apparatus must be extremely difficult. A million volts is incomprehensible and seems impossible.

In no other department of the Exposition, at Chicago, will there be so much to learn as in the electric section. It is, no doubt, the most important and the greatest. On this branch of science has the foremost intellect of all countries been centered for ten years past, and to assume that this country, or any other, is "in advance" can only be true in a very modified sense. Foreign electricians will learn much here, and our people will learn much from them. The more patient scientific methods of investigation in Europe have led to a greater advance skill in the science, while the greater con-

structive skill here has enabled a more complete development of machinery and implements, especially in the apparatus of distribution. One result not altogether desirable will be that foreign firms, like Siemens & Halske, when they learn the prices at which electrical apparatus is sold in this country, will, no doubt, with foreign capital go into the manufacture here. There is a duty of 45 per cent. on machinery, and this is certainly a tempting bait that applies to generating plants mainly. In the minor details there is little hope of emulating American manufactures.

Four years ago we published an article on the "Industries of Ireland" that caused a good deal of comment because it is commonly supposed that there are no industries in Ireland worth mentioning. In the article referred to, Volume I, page 22, we mentioned the fact of an electric railway from Newry to Bessbrook, which has been in successful operation for eight years past. The *Railway World* of London has in their issue for June given a very full and complete account of this electric railway, which can be read with interest and advantage by electrical engineers. We have space for only a few of the facts given. The generating station is near the middle of the line, which is 3.5 miles long. It is an overhead system corresponding very nearly to common practice of our day. Power is derived from the Cambaugh which affords a fall of twenty-eight feet, which is applied on an inward flow or American turbine directly connected to Edison-Hopkinson dynamos that give 90.4 per cent. efficiency and developing sixty-two horse power. The whole line, including the electric plant, was constructed by Messrs. Mather & Platt, of Manchester, England.

A decision of July 1, in the U. S. Circuit District Court of New York, by Judge Lacombe grants an injunction against the Holland House and the Hotel Imperial to restrain them from "using" incandescent electric lamps infringing the Edison patents. The injunction applies after ten days, permitting that period for a change from the infringing lamps. This is the first action against users, and is a matter of grave importance in view of the wide field opened up, and it practically places the incandescent filament lamps at the control of the Edison Company and their licenses. Other suits are to be brought against usesr immediaely, and the chances are that there will be a confirmation of the Edison patents. It is remarkable

that in a case apparently so simple as the carbon filament lamp patent there should be long contested trials as in the Edison-Swan & Edgar trials, but it must be remembered that the invention pertained to a new art, very imperfectly understood, and in which precedents were wanting.

Professor E. J. Houston has been elected president of the American Institute of Electrical Engineers, and certainly no better choice could have been made. His eminence in the electric art clearly entitles him to such distinction, and the present year with so many foreign visitors is a time when some distinguished man should be at the head of so important an organization as the electrical engineers.

The Thomson-Houston Company have brought a test suit against a New Haven railway company that will determine the validity of the Van Depeole patents on the "trolley," as it is called. This is an essential feature of the overhead wire system, and the suit above mentioned is really against the Westinghouse Electric Company, who will have to defend. A trolly running against a wire can hardly, we think, be a patentable feature beyond the method of construction, but its combination with other new and essential elements may be valid subject matter for a patent.

THE NEW EDISON ELECTRIC RAILWAY SYSTEM.

There has been going the rounds of the press for some time past, notes of a wonderful invention by Mr. Edison relating to electrical railways. The invention is thus described in the *Electrical Engineer:*

"Mr. Edison has settled upon a system in which current is carried from the central station at high potential to motor generators placed below the ground and in close proximity to the rails, and which convert the current transmitted at the pressure of, say 1,000 volts, to one of 20 volts between rail and rail, with a corresponding increase in the volume of the current.

With the utilization of heavy currents at low voltage, it became necessary to devise apparatus to pick up with absolute certainty 1,000 amperes of current through two inches of mud if necessary; and this Mr. Edison has done. It was next necessary to obtain a joint between contiguous rails that would permit of the passage of several thousand amperes without introducing undue resistance. This has also been accomplished, with the result that an experi-

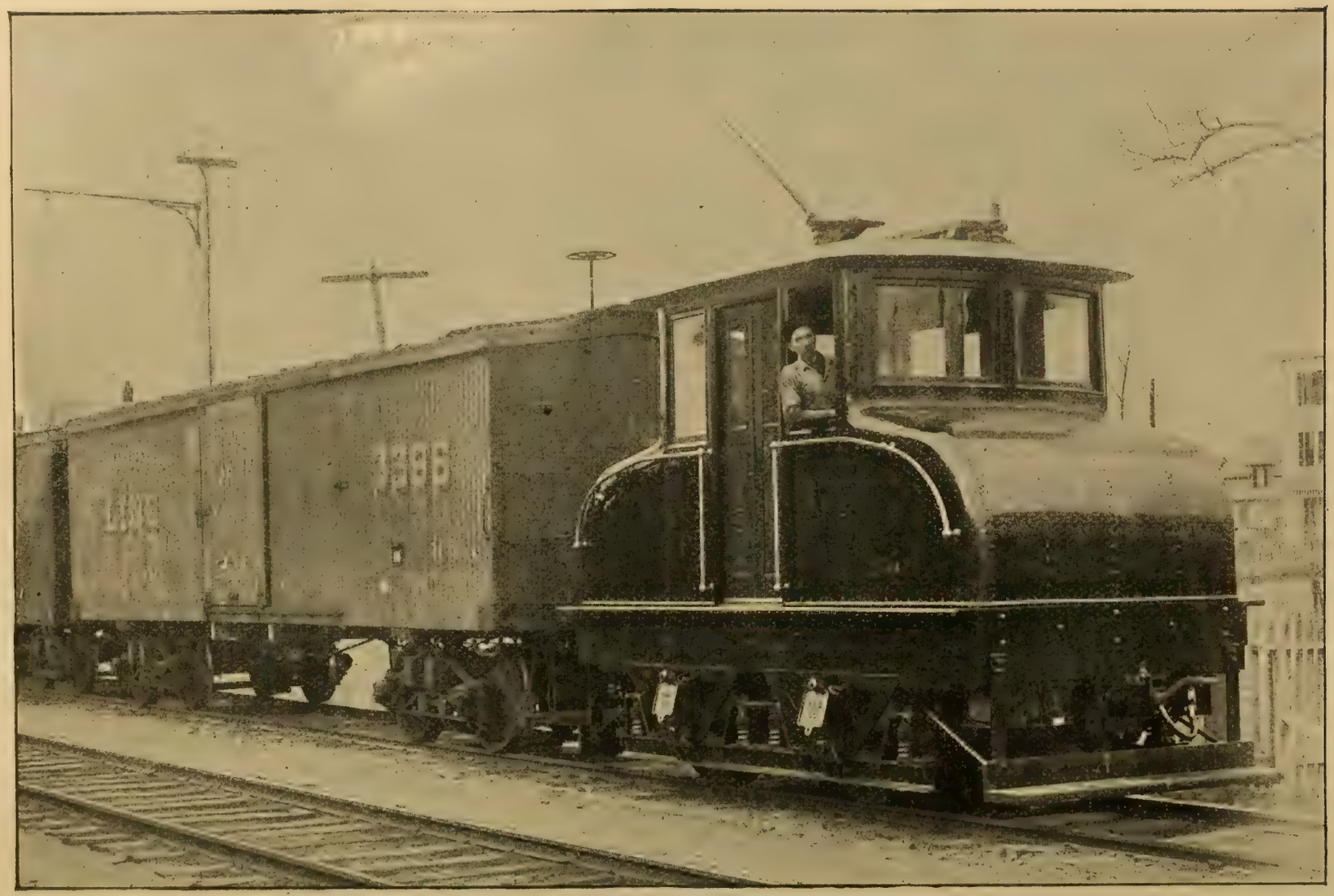
mental track of about a quarter of a mile in length has been in actual operation near Mr. Edison's laboratory for some time past, and working to his complete satisfaction.

It has been said that carriages with iron wheels passing over the tracks would short circuit the current and cause the destruction of the dynamo machines, as well as "chew up" the short-circuiting vehicle. To test this Mr. Edison actually short circuited his experimental track with a carriage having iron wheels, and succeeded in getting only 200 amperes through the wheels, the low voltage used, as well as the insulating properties of the axle grease being sufficient to account for the small quantity of current which actually passed through.

Regarding the leakage of current between rail and rail, Mr. Edison's experiments have proved that at a potential difference of 20 volts the loss under the worst conditions with a wet and salted track is only 5 H. P. per mile, while very wet weather would involve a loss of only 2½ H. P. And as regards the question of safety to human beings and animals liable to come in contact with the rail, it is needless to say that the effect of 20 volts upon the human body is imperceptible, and actual experiment has also shown that horses are not affected by it in the slightest degree. While not differing in principle from the ordinary type of street railway motor, the motor on this system would be practically waterproof without necessitating any special protective covering for that purpose.

The cost of this system, Mr. Edison estimates, will vary between $30,000 and $100,000 per mile of double track, not including the cost of the stations, and depending between these limits upon the amount of traffic. The running expenses, he estimates, will be exactly the same as those on the overhead trolley-wire systems. Where the traffic permits of it the system can be applied with greater economy than a cable road. In conclusion we may add that estimates are now being prepared for the conversion of one of the largest street railways in New York City over to the electric system, after the plan of Mr. Edison, and it is to be hoped that the arrangements will soon be effected by which the system may receive a practical trial on a large scale in the near future."

The *Engineer*, London, says this is the Volks system, pure and simple, and that Mr. Edison, when he goes into technical problems will find it not in the same condition as five years ago.



THIRTY TON ELECTRIC LOCOMOTIVE.—THE GENERAL ELECTRIC CO.

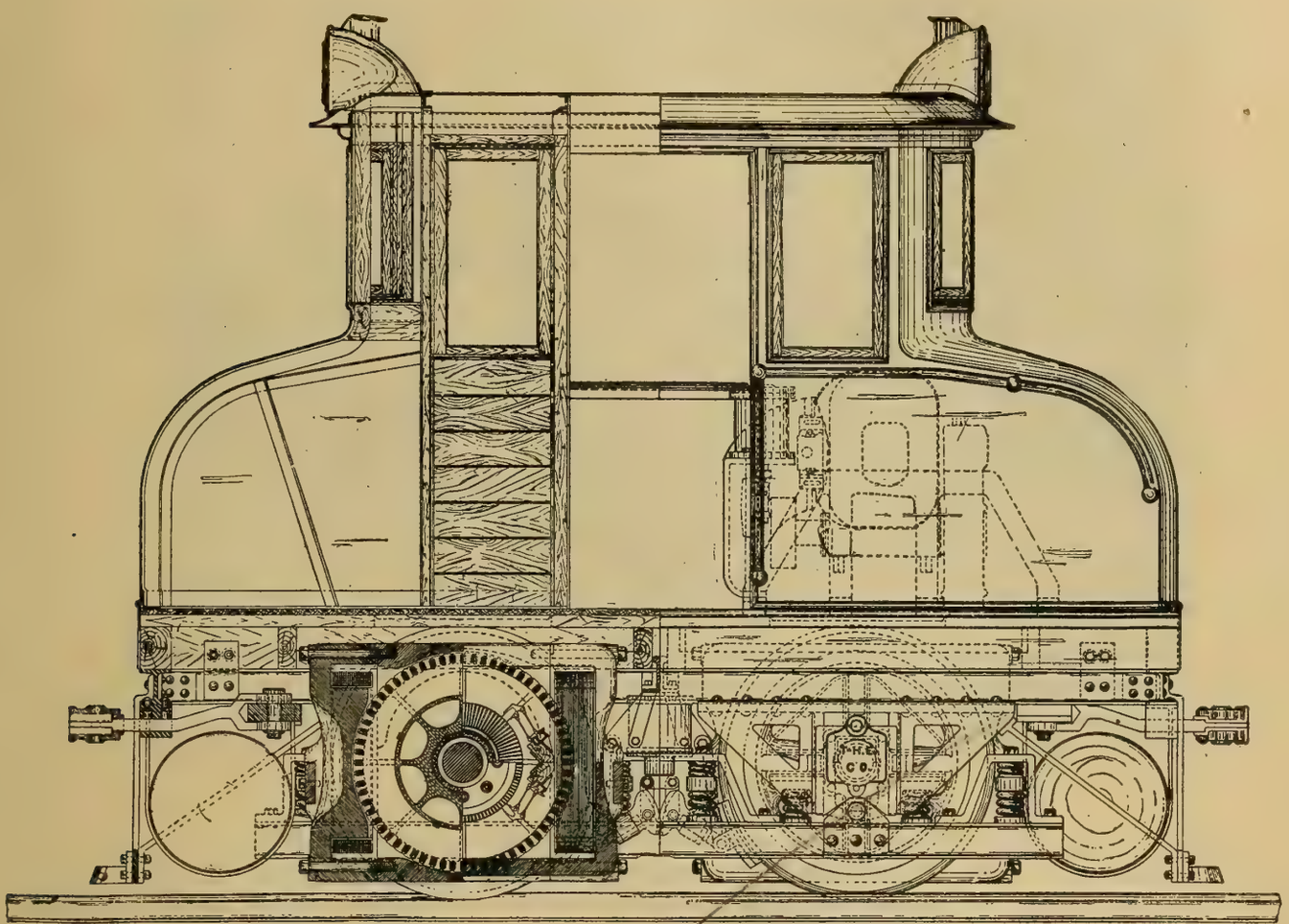


FIG. 2.

A THIRTY TON ELECTRIC LOCOMOTIVE.

THE GENERAL ELECTRIC COMPANY.

The electric locomotive shown in perspective on the opposite page, and in section, Fig. 2 above, is the first one of so large a size produced in this country, and the first made anywhere for service on a common steam railway, and it marks a distinct advance in many ways in this line of electrical development.

The locomotive weighs thirty tons, and is designed for a normal speed of 30 miles an hour. It is intended for operation on elevated railways, and for passenger and light freight traffic on less important steam roads. It is of compact construction, solidly and substantially made, and is mounted on four 44-inch wheels. The main dimensions are : 16 feet 6 inches long, 11 feet 6 inches high, 8 feet 4 inches broad, having its draw bars 2 feet 6 inches from top of the rails, corresponding to the Manhattan Elevated Railway standard. The draw bar pull is estimated at 12,000 pounds.

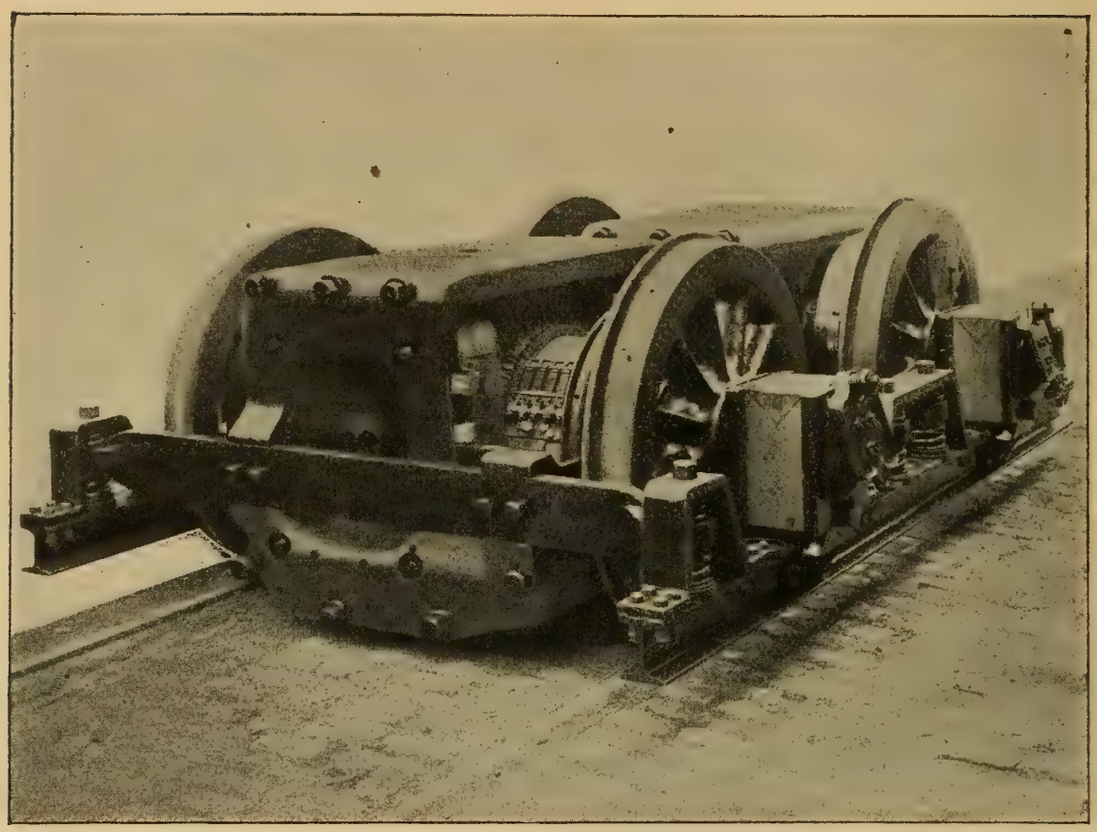


FIG. 3.

Power is furnished by two electric motors of especial design and construction, each axle being provided with a motor. The motors are gearless, and are supported on spiral springs resting on the side frames of the locomotive truck, as shown in Fig. 3. This method of suspension leaves the wheels free to adjust themselves to the irregularities of the road bed, and consequently the wear of both tracks and motors is diminished.

The motor fields consist of massive iron castings, to which the hollow field spools are bolted. The armatures are of the iron clad type, having each separate winding embedded in a mica lined slot cut into the curved surface of the laminated iron armature body. The axles of the locomotive pass through the hollow shafts on which the armatures are mounted. These shafts rest in bearings of the motor frame, and are connected to the axles by universal couplings, which allow freedom of motion in all directions. The commutators are of massive construction and there are four sets of brushes to each commutator.

The motors are controlled by means of a series parallel controller, set up in the interior of the cab. This device embodies all the latest improvements made in this type of apparatus by the General

Electric Company. Under test it is found that the series parallel controller allows of a more gradual and easier starting of the electric motor, and the speed can be more completely controlled than in the case of the steam locomotive.

The truck, suspended from the journal boxes, is constructed of heavy **I** beams, and forms the foundation for the locomotive cab, of sheet iron, of symmetrical design, and so curved off as to diminish the atmospheric resistance, as far as possible. The interior is finished in hard wood. Two sliding doors are placed at each side of the cab, and the windows are so arranged as to permit of an unobstructed view in all directions. There is ample space in the cab for the motor-man's movements, and it affords him considerably better protection than that usually provided for steam locomotive engineers. The position of the head lights is shown in Figure No. 2.

The air for the brake is supplied by a special electrical air compressor, which also operates the whistles. This air pump, shown in Fig. 4, has an oscillating cylinder of six inches diameter, with a

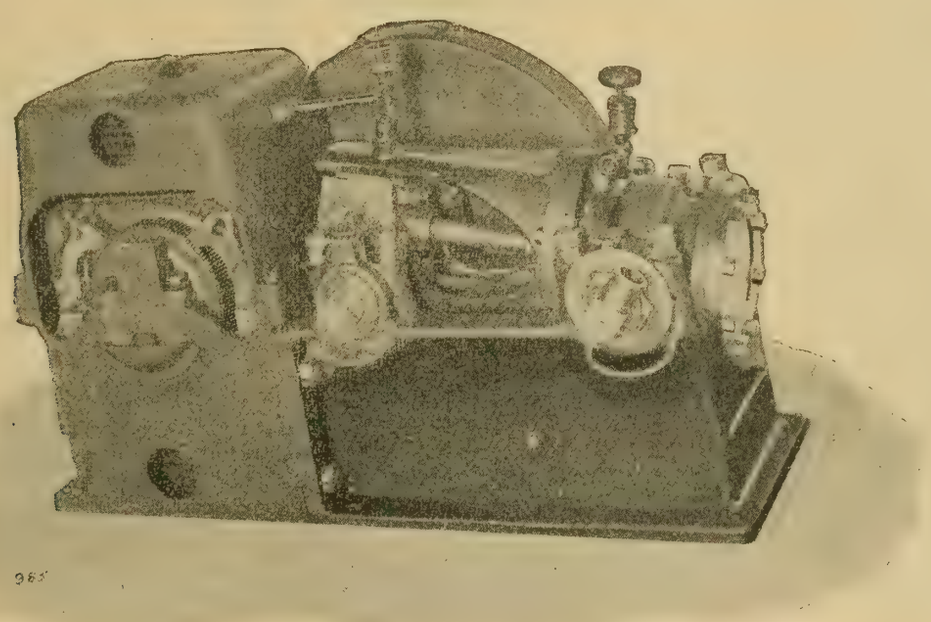


FIG. 4.

six-inch stroke, supplying 6,000 cubic inches of air per minute at 70 lbs. pressure. The normal speed of the armature shaft is 675 revolutions, and of the crank shaft of the pump 110 revolutions. The dimensions of the air compressor are, length 41 inches, width 15½ inches, height 25 inches. The pump motor is controlled by a special rheostat, and this, by an intermediary device, and is automatically regulated by the air pressure.

The use of electric locomotives over very long distance is at

present limited only by the cost of long lines of electric feeders, and until the problem offered by this condition is solved, restriction of its employment must necessarily exist. But for places comparatively near each other and where traffic is dense, the denser the better, the electric locomotive is peculiarly adapted, for all the advantages of electric propulsion are available, unhampered by the extreme expense involved in long feeder lines.

The evolution of the electric locomotive will probably follow along lines dictated by expediency and favoring conditions. At first they will probably be employed for elevated railroad service. They will then probably be adopted as feeders to the trunk lines, both for freight and passenger traffic; and to operate short suburban lines, where a rapid efficient service is requisite. Their peculiar fitness for switching purposes will advance their use another step, and then slowly as the different problems presented are overcome, they will invade the province of the trunk line steam locomotive.

ACCUMULATOR RAILWAYS.

The electric accumulator railway, at Birmingham, Eng., completed in 1890, continues in satisfactory service. The road is about three miles long, and has at one place a grade of three per cent., but is mostly of easy grade. The cells are of the Epstein kind, and are maintained by the electrical company at a rate of three cents per car mile. This requires 2,800 miles to be run to pay for a renewal, but the batteries are good for a longer distance, reaching 4,000 car miles.

The plates used are solid lead castings corrugated on both sides, and converted by direct process into peroxide so that no paste is required. There are ninety-six cells to a car, eight plates to a cell. The company have sixteen cars that are driven at eight miles an hour. The *Street Railway Journal*, of last month, contains a full account of the line, and says of the charging appliances:

"The charging room is 75×63 feet, and has four tracks, all provided with pits. The charging is effected in a simple and ingenious manner. Two of the tracks in the charging house are used for cars requiring to be supplied with batteries freshly charged; each of these lies between two hydraulic elevators having eight shelves each, and capable of storing sufficient cells for working all the cars of the line. When a car is to be charged with fresh cells it is run between the elevators, which are so placed that a vacant shelf is on the level of the floor of the car. The exhausted cells are then drawn out, a shelf containing freshly-charged cells brought to the proper level and the fresh cells pushed into place, the entire operation requiring

but two men for two or three minutes. The cells are charged in place on the lifts in the following manner: The cables from the dynamos are connected with the frames of the elevators along which run vertical copper strips, which are connected with the cells on each shelf by contact springs, so that at whatever position the elevators may be, the charging is constant. The contact between the cells and the trays on which they rest is made automatically."

This description should contain some hints for those engaged in the storage-propulsion problem here, because it is on this part of a plant that must depend to a great extent the impressions of success. Some of the lines here are level enough to be driven by accumulator batteries, and will be, no doubt, if reasonable economy can be maintained, and this is within measurable distance of success, because there is certainly a margin of improvement to reckon upon, and just now there is especial activity in improving storage batteries.

ITALIAN ELECTRIC PLANT.

A lately erected power plant at Genoa, Italy, is one of the most remarkable in the world.

Water is collected from springs in the mountains twenty miles away, 1,860 feet above the sea, amounting to 6,600 gallons per minute. This water is let down by stages from one reservoir to another, the first fall being 380 feet, from which 746 horse power is derived; the second fall is 364 feet, affording 720 horse power, and a third fall is 490 feet giving 960 horse power, or collectively 2,426 horse power.

Girard or partial turbine wheels are employed, one plant being constructed by Fæsch & Picard of Geneva, the firm that supplied the plans for the wheels to be erected at Niagara Falls. The power at Genoa is employed mainly for lighting, being conducted by wires from the different stations, but with an efficiency the highest, no doubt, ever attained by electrical apparatus of the kind.

The following report of working is taken from *Electricity*, London:

"The efficiency of the generating machines and multipolar (6 poles) motors is guaranteed at 90 per cent., but exceeds this figure by 1 to 2½ per cent. For the other motors this efficiency varies from 85 to 89 per cent.; this latter figure may be taken as the mean efficiency.

The length of the line of transmission is 60 kilometros (37⅓ miles); the loss in the line is about 500 volts. Its efficiency, therefore, is 90 per cent., and the final efficiency of the transmission is,

therefore, $\frac{90 \times 80 \times 90}{100 \times 100 \times 100} = 72$ per cent. which represents the ratio of the effective horse power of the motors to the indicated horse power on the turbine shaft. This efficiency, of course, is lower at a small load, while it is higher at full load of 6,000 volts.

Mr. Thury, the talented engineer-in-chief of the Société de l'Industrie Electrique, of Geneva, has thus solved in the simplest possible manner the difficult problem of series distribution at high pressure.

We can now, thanks to his persevering efforts, commercially utilize continuous currents of 6,000 volts and more; Mr. Preve, in fact, proposes to work with currents of 10,000 volts, and to add for this purpose two more groups of 140 horse power at each of the two last stations.

As we have already stated at the beginning, this is the most important and most interesting installation of its kind in Europe."



ELECTRICAL ILLUMINATION.

During the recent naval display at New York, the Russian Admiral had his flagship, the *Dmitri Donskoi*, decorated with incandescent lamps as shown in the drawing above. The effect of these

hundreds of lamps dispersed in symmetrical and symbolic form was attractive and novel. The occasion was the birthday of the Czarovitch, or Crown Prince of Russia, and the emblems in the center are the Imperial Crown of Russia, and the initial Greek letter of the Emperor's name. The work was done by the General Electric Co., in conjunction with the Russian officers.

COMMENTS.

Mr. Albert A. Pope, a maker of bicycles at Hartford, Connecticut, is a veritable Sam Slick in the methods of advertising his wares. The Government graciously insures him a premium of 45 per cent. on his manufactures, which, without this, would be at least one half profit, and he collects this amount from young people who are given to this kind of locomotion. This, of course, places in Mr. Pope's hands a large amount of money, which he seems to mistake for a plethora of intellect, and sets out accordingly to instruct his less informed countrymen respecting roads, errors in school books, and so on, always bringing in by some kind of ruse his famous velocipedes. We commend him to Mr. Bierce, who could, if he was so disposed, arrive at a true estimate of this cycle philanthropist and the offensive nature of his advertising methods.

Mr. Carnegie says steel is a cent a pound, which is certainly a low price, entirely too low, and he would no doubt be surprised to know that the tariff on steel to keep up the price is the main cause of keeping it down. The prices in a country that consumes its own manufactured products are a very uncertain matter. Nothing but a trade in the neutral markets of the world can create stability of prices. If, for example, steel is a cent a pound, why do not the makers here furnish steel in South and Central America, China, and Japan, or even in Europe? The reason is we have no connection; former prices shut us out of the markets of the world, and the trade can not be caught up at once. Unnatural stimulation has more than once overdone the iron and steel business in this country. Interference with prices by taxes assessed on commerce has always the same effect of "up and down." First a "boom" then a panic. The national resources of this country are enough to work complete success in any line if let alone.

The *Iron Trade Review*, speaking of the late Treasury ruling that dipping or coating with tin foreign-made plates was not an American manufacture, says, "logically carried out it would call no article American made unless every component was dug from American hills, or hewn from American forests." How sincere this is we cannot judge, but "logically" it seems to us that when nine tenths of the components in this case have paid a duty, there is something wanting in the "logic," and in any analogy we can think of. People do not dig iron plates, or even block tin, out of American hills, and the principal fact, in the manufacture referred to, is between the ores and the product, the work done abroad and dutiable. It reminds one of the importation of "left hand gloves," which the consignee would not receive, and left to be sold by the customs department. His brother in another city, was in the same plight with a lot of "right hand gloves," but by bidding in the goods at an appraiser's sale, and combining the two lots, they became a useful and perhaps an American product. The remaining thing to be done in tin seems to be a subsidy equal to the cost of dipping.

The latest enterprise in the railway world is the Denver and San Francisco line, an enterprise started in Denver, and endorsed by a large number of experienced and wealthy men there. The account of the matter has, in all respects save one, the appearance of good faith, and that is the failure of these wealthy men to subscribe for the stock, or, in other words, put their own money into the proposed railway. As soon as the amount of bona-fide subscriptions at Denver are known, then one can tell very well whether a line is to be constructed or not. The route is mainly through a new country, shorter than D. R. & W. line, and with better grades. There is no difficulty in the matter except the one above noted. People here will help to build and support the line when they know it is started in good faith, and that the promoters are themselves assuming a fair risk. We suggest that when they are ready it will be a good plan to hunt up a "Jim Hill" to build the road, and do it on what he calls "business principles," so that when done it may be operated as any other business property, upon a fair invoice of value.

The loss of the *Victoria*, in the Mediterranean Sea, is an awful disaster, accompanied by the unexpected on every hand. The useless investigation and search for causes that led to the collision

occupy attention, because that is all there is to talk about. Four hundred people drowned in the midst of a fleet and near to the land seems incredulous. The *Victoria* was 360 feet long, 10,000 tons displacement, and 14,000 horse power; the flagship of the fleet, first class, and only four years old. The celluar spaces at the bottom of the ship that could not fill, with her heavy armament on the main deck, turned her over as soon as she filled with water at her axis, or to one side, above the double bottom. At this day the ponderous engines of such vessels are constructed without foundation framing, only a sole plate, to so call it, being provided, the main framing being built into the ship. This calls for deep keelson, and a hollow bottom, no doubt four feet or more between, in such a vessel as the *Victoria*. This space acts as a turning force as soon as the ship partially fills with water.

Now that people are beginning to understand something more than formerly respecting the capitalization of railways in this country, there is but little confidence in their reports of earnings. A late writer on the subject places the nominal capital of American railways at "ten times" the amount of actual investment, so that earnings of one per cent. on rated capital shares is ten per cent. upon the actual capital or proper cost of the lines. This is the margin Mr. Hill of the Great Northern line is working upon, and it is hard to see how the watered and expensively managed lines are to compete with him for transcontinental traffic when his capital on which earnings are computed is about one fourth as much. This Great Northern Railway is an accomplished fact, built without syndicates, Credit Mobilier, or other tricks to direct money from the work of construction into private pockets and have the amount charged up to stock. It is built honestly and without "manipulation" or "connubiation" as it is called. It parallels the Northern Pacific for 2,000 miles and represents one third as much capital. Mr. Hill is just now master of the situation and deserves to be.

It is no doubt a wonder to many people that among the almost universal failure of banks nothing has been heard of Canada. No banks have failed there and there has been no rumor of insecurity. The shares of the Bank of Montreal stand 9 per cent. above par; the Merchants' Canadian Bank 58 per cent. premium, and the Canadian Bank of Commerce over 200 per cent. premium. The

reason of this, says the *Ohio Valley Manufacturer*, is that these banks are properly managed, have a perfect system of inspection and an equally perfect system of promotion. Had the Canadians continued with the fiscal policy of twenty years ago or rather had they maintained the high rank of their civil service such as it was then, there would have been a phenominal prosperity in the Dominion. They undertook under the conservative *regime* to establish manufactures by law and began piling up an enormous debt. There woolen manufactures sprang up like magic, and in three years went out and died, but some departments of their internal economy remained sound, among these and especially, are the banks.

The Iron and Steel Institute of Great Britain has done a graceful act in conferring the "Bessemer Medal" of 1893 on John Fritz, founder and chief engineer of the great steel works at Bethlehem, Pa. This is a great honor and a mark of esteem that deserves, as it will no doubt receive, kindly acknowledgment by the profession in this country. The council of the American Society of Mechanical Engineers have already in fitting terms noticed this courtesy to Engineer Fritz; a pleasant duty, as our readers will conclude after reading the account of the John Fritz re-union we publish elsewhere in this number. It is a hopeful sign to see national lines broken down in the field of science and learning. Two things that seem to have risen above the line of bigotry, prejudice, war and other barriers.

Those searching for ideas on the silver question can find one in Congressman Cockran's late essay on this subject in the *North American Review*, in which he says there was no need for the Government "warehousing" silver under the Sherman Act. That was the proper business of private firms, and that the silver could have been stored anywhere, and the receipts sold up to nearly or quite the same rate the Government issues them at, but with the very great difference that the silver would have been spread in the market and resold all over the world, bringing us gold in return instead of draining it out of the country. He calls the legislation which produced the Sherman Act and its predecessor, the Bland one, "senseless," and his selection of an adjective is moderate. He also claims that silver would never have sunk to its present price had it not been for the Sherman law, which is certainly true. Such laws commonly act "backward."

It is customary for some one, every now and then, to rail at the U. S. Patent Office for granting patents on old devices. In a recent case a contemporary rated the Patent Bureau for issuing patents on down draught, which was as old as the Greeks. This is wit perhaps, but not fact, as the writer will find out when he has a case to present at the office. It is not likely anyone ever procured a patent on "down draught" in this country, such a thing is impossible, but a good many patents have been granted on the means of producing down draught, and legitimately too. The term itself expresses a function or mode of operating which is not patentable at all. There are objections to our patent system, as to the patent system, but it is not in granting invalid patents, at least is not in this country. Errors are sometimes made, undoubtedly, and the office assumes the power to reject or destroy an application, without on the other hand any power to confirm a grant when issued, but as to patents on old things, such a thing cannot happen very often, and when it does cannot do much harm.

Some companies in the faithful zone, at the East, have bethought themselves of manufacturing a little cheap political capital by applying to English makers for quotations on ship iron. They should not do so, but buy American iron regardless of price. That would be the patriotic way. The remedy is, however, to provide the iron here at a price that will prevent its importation. This, the *Marine Review* says, will be done on the lakes. If it is claimed this cannot be done, which would hardly be true, we can ascribe the reason to extra cost of producing, due to inflated prices for many things the iron and steel workers consume. We do not include labor, that will "equalize" itself. We cannot, however, in reason expect steel and iron to come down to a rate that prevents importation when everything else in the way of material bears an inflated price. If the whole system of duties were lopped off, the American manufacturers would soon settle the problem of importation of iron and almost everything else.

The supply of causes for the present money stringency in this country keep on accumulating until the wonder is that affairs are not worse than they really are. The excess of imports over exports last year is certainly enough to show how gold has been drawn away and debts created. In 1891 the exports of merchandise from this country exceeded imports by nearly 200 millions, and we

received therefor a balance of $600,000 in gold over what was sent away. In 1891, when the new tariff act was to have arrested imports, we bought 88 millions more than we sold, making a change of nearly 300 millions that had to be provided for in our money resources. This extraordinary change of affairs was due to a number of causes, mainly, no doubt, to the fluctuation of crops and the lower prices of food supplies in 1892. The decline in wheat, maize, and cotton between 1891 and 1892 is estimated at 500 millions. It would be a bold economist who, after making all allowances, would claim that a higher rate of customs duty has done anything to diminish imports. Facts point to a different result, as before said, there has been a conjunction of causes, natural and otherwise, for depression, many more indeed than are required, and no fault should be found with the result.

We are informed by a circular sent by Messrs. Harvey, Fisk and Sons, dealers in U. S. Bonds, New York, that "our country is threatened with one of the greatest disasters since the civil war, and that its institutions are being shaken to their very foundation," because the President will not convene Congress to repeal the Silver Act of 1890. Not being skilled in the intricacies of finance, which is an "art" or "science" not amenable to exact laws, we should perhaps accept Messrs. Harvey, Fisk and Sons' dictum in this matter, but must continue to think that this silver purchase law is but one among many causes of present distrust and failures, and that watered stocks, pension squanderings, abnormal taxes assessed on consumption, money grabbing, lobby legislation and general waste of public funds, with a dozen more causes, should be set alongside the Sherman Law, or the silver miners' law it should be called. It would be a pleasure to accept the circular above named as an evidence of patriotic interest, but it calls to mind a German proverb, *Da liegt der hund begraben.*

Mr. Andrew Carnegie, the "Star Spangled Scotchman," as he is called by his countrymen, has placed the American people under an obligation by various writings of his, that have done a good deal towards calling attention to a fiscal policy that has made him very rich, if not very learned. Having now settled the economics of two worlds he proposes to unite them, and make one nation of Great Britain and America, which will now be a congenial job, the steel

making business being happily out of the way. As Mark Twain observes in one of his books, "We cannot help admiring a man who carries around ideas of this size." In the statistical part of his article on the subject, published in the *North American Review*, there are estimates respecting national debt and taxation per head in the two countries that are ridiculous. Taxation depends on what Mr. Carnegie includes under that head, and national debt depends on how much property a government owns to offset debt. For example, Great Britain is set down at $88, and this country at $14 per head. This includes, of course, securities issued against property, but, as we imagine, not paper money. The fact is, that no union of the two countries is probable, or possible. The methods of government, internal policy, tastes, habits, and everything is different, besides, there is quite enough contention and prejudice now without a "union," but as no one but Mr. Carnegie has the matter in hand at present, no preparation is called for yet.

ENGINEERING NOTES.

In a discussion on street motors, before the American Institute of Electrical Engineers last year, the friction of gearing was considered and a consensus of opinions would be discouraging to roller-bearing advocates. Mr. C. G. Curtis, in speaking of journal friction, says: "Certainly the loss from friction on the bearings is not worth speaking of. A gearless motor has an advantage in that respect over any other form for the simple reason that the torque is transmitted to the wheels symmetrically with respect to the axle. There is no thrust tending to throw the armature out of its position; whereas, with a geared motor there is a great thrust. But even with that thrust the friction is so little that it is hardly worth speaking of." This is not a scientific but a practical view of the case. The common and unskilled view of friction, sees in that element the principal resistance to machinery, whereas it is only an inconsiderable element in rotary bearings that are well made and of good material. A friction coefficient of .05 is a narrow margin for roller bearings and is enough to assume for good bearings.

The American consul, at St. Etienne, France, reports a very novel invention there of producing threads of collodion, liquid fiber it may be called, and after toughening spin them into yarn and cloth

that has the characteristic of silk. The conversion of plastic or viscous substances into threads or cloth seems a very possible achievement, and would be a very important one. In the present case wood fiber is employed. It is first dried in an oven, then immersed in a mixture of sulphuric and nitric acids, is next washed several times in water and ether, and dried by alcohol. The preparation thus produced is then dissolved in ether and alcohol, producing a collodion which is extremely viscous. Threads are produced by forcing the collodion through minute apertures, and treating it with alkalines to render it tough and dry. This particular case may not determine a great deal, the problem is a wide one. Wool, cotton, flax and silk are all expensive, and something cheap to substitute either of them would be a revolution.

Mr. David Joy, the inventor of what is known as Joy's valve gearing, which reverses without a link and with one eccentric, has produced a new reversing gearing that is extremely novel and may survive and supplant present practice in many cases. It consists in mounting an eccentric on slides so it will move across the crank shaft and applying at each side small hydraulic or oil pistons to move it. These pistons are in communication with a stationary piston controlled by a lever so the oil can be forced from one side of the eccentric to the other, moving it positively and holding it firmly unless the oil should escape. The same thing was applied here to winding engines about ten years ago. The crank pins of a pair of hydraulic engines were shifted out from the center either way by similar pistons to govern the stroke and to reverse the motion, and brought central to stop. The main object was to save water in the engines, which was by this arrangement consumed in only proportion to the load. We are not aware of how the scheme succeeded.

At a more sanguine period of life, many years ago, we concluded to revolutionize an "art" by pointing out that grindstone boxes should not be circular, or semicircular, but rectangular. We expatiated on the advantages in pattern making, in symmetry, and the gain in capacity to contain water and sediment, also put the matter to proof by constructing two sizes of grindstone frames in this form, engraving them and calling in friends to look at the machines. Every one admitted without cavil, the advantages of use, cost and appearance, but no one has ever since, so far as known, made any-

thing but a semicircular box to mount a grindstone in, and no one has ever shown why an angular or square box is not best. We gained in that experiment, half the cost of patterns, also the commendation of those who purchased the grindstone frames, but the main gain was a large modicum of experience, namely: That such improvements must be "hammered in."

The rapid transit commission in New York City has cost $116,000, and is, if not where it started, at least very near the same place. The main impediment to progress is, we fear, very much the same that attended in the preliminary work for the World's Fair in 1889, there are too many private interests to be considered. One difficulty has been a search after novelty and neglect of the proposition that the conveyance of passengers is much the same problem everywhere and requires nearly the same means if we except methods of propulsion, which is a secondary matter. To generalize on the subject, the traffic must go over or under the plane occupied by the buildings and people, and if put over head and high enough, streets need not be regarded. This may become the final system, as has been suggested by an Italian engineer.

In the *Mechanical World* we find the following rule for determining the velocity of fracture or "bursting speed" of wheels of any kind of material:

$$\text{"}V = \sqrt{\frac{g \times T}{12 \times C}} \ldots\ldots$$

V = velocity of rim in feet per second, $g = 32.2$, T = tensile strength of material, C = weight of a cubic inch of material. For cast iron we have T = 18,000, C = 0.26; for wrought iron T = 50,000, C = 0.27; for cast steel T = 75,000, C = 0.28. Therefore

$$V = \sqrt{\frac{32.2 \times 18{,}000}{12 \times 0.26}} = 431$$ feet per second for cast iron, without regard to the actual dimensions of the wheel. It is usual not to allow the speed to exceed 80 to 100 feet per second."

This is all very well and not new, but how is "T" to be ascertained? It is an old example of formulæ to be fitted to tacts.

The *Irrigation Age* gives some account of a dam of granite ashlar work, being constructed in the San Jacinto Valley near Riverside, Cal., that is a very remarkable work. The dam is to impound water for irrigating purposes and will store eight billion gallons of water. The dam is to be 150 feet high and commands a catchment

area of more than 100 square miles, which seems small, but the rain fall at that elevation, 4,000 feet, is forty-five inches a year. The available areas of rich land on which the water can be supplied exceeds 30,000 acres of mesa plains, in the San Jacinto Valley, lying far below at levels of 2,000 feet or more, so the water, besides its use for irrigation, will give out an enormous amount of power. The blocks of granite used are all of large size to save cement, which is expensive to haul up to such an elevation over mountain roads, also to secure a safe work. This dam, of which very little has been heard, is claimed to be the finest one ever constructed in this country.

We, some time ago, asked a well-known ship builder, of this City, how it was possible that Harlan and Wolff's, at Belfast, had attained such eminence among European ship yards. His answer was: "I will illustrate it by a circumstance that happened not long ago. One of the White Star steamers was in port here, and the chief engineer wanted a door in his department divided transversely so he could open the top part independently. We sent a man to cut the door in two, and when he had sawed into the edge a little way he struck iron. Thinking it was a nail or screw he turned the door around and sawed in on the other side, and again struck iron. We then examined the door, and found it contained an iron plate let into the stiles, and covered with wood panels outside. There was no sign of iron when the door was finished. It was careful honest work, and that is what has built up the Belfast business."

Professor Biles' paper on fast steamships, in the *North American Review*, appears under headlines of "Thirty Knots an Hour to Europe." It is a plain common-sense view of the various "economics" involved in the problem, ending with the prophesy that the conditions will permit in the future sometime, a speed of thirty knots an hour. This will call for ships 1,000 feet long, 100 feet wide, and 30 feet draught, more concentrated fuel, stronger material, lighter boilers, and a good many things to be yet learned. Professor Biles designed the *Paris* and *New York*, also assisted in preparing plans for the other ships to be built in this country for the American line, and is an authority on this subject if there be one. As a matter of fact the torpedo boats some of them, exceed the estimate above, if size is taken into account. Some of these have run at 26 and 27 miles an hour, and a "size allowance" would give them much more than 30 miles an hour.

It is only four years ago when we complained that there was great neglect of cold iron saws in this country and that such machines were being imported by works here because machine toolmakers could not furnish such implements. This state of the trade has much changed, and now we receive a circular illustrating nineteen modifications of cold sawing machines made by the Newton Machine Tool Works at Philadelphia. All well designed machines with automatic sharpening apparatus, and a list of more than 100 firms and companies who have adopted such machines. Band saws are also mentioned and described, but this branch does not seem to have made so much progress. In the Armstrong Works at New Castle, England, there are fifteen band sawing machines in one room, employed in cutting out test pieces and for various other purposes.

The most remarkable feature of the *Campania* is the piston speed of her engines. This foots up nearly 1,000 feet per minute, with a stroke of only five feet. The movement of pistons more than eight feet in diameter at this rate has no parallel in land practice and is not likely to have, unless it be with certain long stroke engines. There is also the requirement of running 150 to 160 hours without a stop. This is an imperative condition and is attained, because in numerous trips across the Atlantic, twenty or more, we have never seen the engines stop half a dozen times in all. How this can be done surpasses conjecture. There are, of course, rules for "setting up" and special knowledge to be applied in emergencies, but behind all is the excellent workmanship on this class of machinery. A marine engine not well made is of no use, and in all countries there is especial skill devoted to such work.

The Ferris wheel at Chicago is in many respects an advance on the great tower at Paris. It involves machine action to a greater extent and is original as a conception or scheme. The revolving elements weigh over 1,000 tons, and the axis, of steel, is 33 inches in diameter, 45 feet long and weighs 44 tons. This is the most wonderful part of all and is the largest forging ever made in this country; perhaps not exceeded anywhere. It was prepared by the Bethlehem Company in Pennsylvania. The wheel is 250 feet in diameter and has thirty-six pendulous carriages suspended at the periphery, each having seats for sixty persons, or in all 2,160. The cost of the whole plant was $300,000. An engine of 1,000 horse power is employed to drive the wheel, which revolves three times an hour. The scheme is unique and the tolls at 50 cents a head will no doubt reimburse the company that constructed it.

LOCAL NOTES.

P. J. Flynn, C. E., a member of the Technical Society, and known to many of our readers, died at Los Angeles, Cal., on the first day of June. Mr. Flynn made a specialty of hydraulic works, and was for many years engaged on British Government Works in India. He enjoyed a thorough technical education, and is well known in this country by his writings on mathematical propositions connected with hydraulics, and especially by his work on irrigation, a large volume which we reviewed two years ago, and which is a standard work of reference. Mr. Flynn was a native of Ireland, and was educated near London, passed a successful examination for the Indian service and was sent out there. He has been identified with many large and important works in the southern part of this State, and leaves a host of friends.

Throughout the shifting of tariff rates, and trade restrictions of one kind or another, workers in leather have escaped taxes on their raw material. Hides have been bought free in the market, and it would be hard to name another industry that has prospered more, or is on a better basis to day, and for all days, than the leather industries. The competition invited has led our people to excel in implements and processes to such an extent as to maintain a large and permanent export trade, even here in San Francisco. The H. N. Cook Company, the Royer works, and others go on with a fair business, while other industries are so much depressed. We visited the first named establishment recently, and found it full of workmen, leather and goods. The industry, as a whole, compared with woolen manufactures, show an amazing difference, but compared with cotton we find an analogy. Cotton is free like hides, and American skill can be trusted for the rest.

The San Francisco Tool Company, of this City, have contracted to furnish for the Lisbon Reclamation District, on the lower Sacramento River, two centrifugal pumping engines of large capacity, the pumps being of 30 inches bore, and the pipes 36 inches diameter. The engines, which are directly attached, will be of the triple-expansion condensing type, with cylinders 8, 12 and 22 inches in diameter and 16 inches stroke. Jet condensers and air pumps will be constructed

integrally with the engines. There will be two sets of Babcock and Wilcox water-tube boilers, and independent feed pumps, also a Goubert feed water heater; the whole to be set on concrete foundations. The estimated capacity of the plant is 480,000 cubic feet an hour, or 60,000 gallons per minute, against a head of 20 feet. Raising large amounts of water for both reclamation and irrigation purposes is likely to form a considerable part of the future engineering work on this Coast, and is deserving of study and attention at this time.

An International Irrigation Congress is called to meet at Los Angeles, Cal., October 10th to 15th of this year, and the Department of State, at Washington, has issued a circular to the diplomatic officers of the Government in various foreign countries directing them to informally invite the appointment of delegates to the congress above named. The Trans-Mississippi Congress at their last meeting in Ogden, Utah, April 1893, requested by a resolution that such foreign invitations be given, and the Los Angeles meeting will, no doubt, be a very extensive and important one. The phenomenal development in this country during three years past of the irrigation interest is almost inconceivable, and an evidence of an equally remarkable neglect previous to that time. The history of the world for ages past has furnished in many lands facts that should much sooner have attracted attention here, and would have done so had it not been that arid regions were not occupied, and their possibilities not even conjectured.

The value of newspaper reports is illustrated by a circumstance that happened here last month. A fire at Sausalito, on July 4th, burned out the water-front row of houses next the ferry landing. This is six miles away, at the other end of a ferry route, and in plain view of the city. Taking the accounts given in the two principal daily papers we have as follows: "Among the places destroyed was the Sausalito Hotel" (not touched.) "Belknap's real estate office, and the stairs leading to the El Monte Hotel were burned" (not touched). "The *Sausalito News* whole plant destroyed" (no fire within a hundred feet). "The trees in the garden of Mr. W. G. Barrett were destroyed by the flames" (no fire within 200 feet). It is not these and other inaccuracies of this particular case we are calling attention to so much as the unreliable nature of news of all kinds purveyed by the press of our day. We do not as a rule publish news of any kind that has not some bearing

upon industrial affairs, and of general interest, but even in this narrow field fear to transcribe anything under the head of "news." The announcement of the building of the *Gigantic*, at Belfast, a steamer 700 feet long has gone the rounds without any foundation in fact. So have innumerable other myths of the kind.

The mining section of INDUSTRY for this month is something like the celebrated chapter on the snakes of Iceland, which read: "There are no snakes in Iceland." It is nearly impossible to equalize the subject matter of a serial journal dealing with subjects extending over so wide a field as this one does, and an attempt to do so would impair the interest and value of what is published. Just now the apathy in all that pertains to silver mining and, to a great extent, lead, has stopped research and invention accordingly, and the economic problems have completely supplanted the mechanical and engineering part. Next month we hope the mining section will occupy its usual allotment of space.

U. S. Chief Naval Constructor, Theodore D. Wilson, has asked for and obtained two years leave of absence, and will come out to this coast in the autumn to remain through the winter, and perhaps longer. The services of Constructor Wilson, when gone over in detail and their nature considered, are amazing. Since his apprenticeship under Constructor Delano, at the U. S. Navy Yard in Brooklyn, his life has been one round of active service, the only interlude being a divergence for a time to the army in 1861. He returned, however, to naval service in time to participate in the action at Hampton Roads, and after some active service at sea, was on duty as a constructor at Pensacola and Philadelphia, then became instructor in shipbuilding and naval architecture at Annapolis; then was sent abroad on special service. Next was on duty at Portsmouth as constructor, and became a member of the Naval Advisory Board. In 1882 became chief naval constructor and was reappointed for three consecutive terms, making twelve years in all, and it is not too much to say that the new navy of the United States has been constructed under his charge. It will be a duty and a pleasure for the people on this Coast to extend to Chief Constructor Wilson such honors as his extraordinary public services demand.

Messrs. Dickie Brothers are just completing at Sausalito a small coasting vessel, to the order of Messrs. Campbell Brothers, for service between this City and Point Reyes. The vessel will be schooner rigged and fitted with gas engines of 25 horse power by the Pacific Gas Engine Company of this City, who have the engines nearly completed. The vessel is about 60 feet long, 14 feet beam, built in an exceptionally strong manner, and by the aid of her machinery will make regular trips on time between the ports. The engines, which we have examined, seem to be exceptionally well made, the main cylinders set diagonal, radial from the shaft, so as to occupy less than the usual space fore and aft, as well as athwartship. The space is wonderfully small for 25 horse power, but all parts are freely accessible, more so, indeed, than is common with engines of any kind. The company are just completing a set of marine gas engines of 40 horse power. The cylinders, four in number, are set athwartship, so the turning moment will be uniform on the shaft. The peculiar adaptation of gas engines as an auxiliary power that can be instantly started will no doubt develop an extended use of this kind of motive power here, where there are lee shores to keep away from, calms, expensive pilotage, and numerous narrow channels to navigate.

In another place we print some remarks upon the want of facilities in the U. S. Patent Office, to which especial attention is called. It is not desirable to be all the time grumbling, but as our contemporaries furnish the optimism and adulation there is enough of that already, and we will add to numerous other complaints one more against the despicable system of politics that prevents the promotion of any public interest that has "no money in it." The Patent Office has to its credit the sum of nearly four millions of dollars, and cannot be provided with the office room required for the bureau. If there were private interests involved, and "something in it for politics," there would be no lack of congressional bills and promoters to secure the required appropriation for extending the office or providing other room for the Department of the Interior, which occupies a large share of the present Patent Office Building. Sufficient room could be obtained by destroying the models in the museum. Nine tenths of these are not only useless, but a sign of provincialism, and can well be spared.

MISCELLANEOUS NOTES.

The New York *World*, in a recent circular, says 139,262,685 papers were sent out in 1892. Equal to 380,500 a day, and nearly four and a half per second for the whole time. This, it is claimed, is the largest circulation of any paper printed in the English language, and consequently in the world. Modern unrest, a craving for news, and the commercial activity born of the struggle for money, renders possible such a vast "machine" as this in our human economy. Whether it betokens advancing civilization is a question, but with this a great journal has no direct concern. It is wanted and is bought. Its maintainance calls into play powers and agencies non-existent a short time ago, and a marvel at any time.

The great Mexican volcano mountain Popocatepelt, that has so long perplexed school children by its name, is now to be turned to useful account. It is 17,784 feet high, and the crater contains an endless amount of sulphur which can be run down on telpher lines, and when the supply of sulphur is sufficient, the line can be set at work on ice, which lies in strange contiguity to the sulphur. The *Mining Standard*, Sydney, says a company of British and American capitalists have the work in hand. This seems like going a long way to look up a job, unless, as is possible, the romance of the thing is one element in the enterprise.

The progress of destructive agencies might be called ludicrous if the subject was not so serious. The British Government is now preparing "torpedo-boat catchers," six of which have been ordered, and eight more in prospective. They seem to be very fast vessels with some kind of armament or rig to destroy common torpedo boats. Now is the time for some other nation to come forward with something to "catch the catchers." It is to be hoped that some time common sense and humanity will stop this waste of human effort and earnings, and that this worse than useless waste of wealth can be directed to some purpose more rational and benificent.

The number of French ships passing through the Suez Canal has fallen from the second to the fifth place, and the *Steamship* thus speaks of the French ship bounty system:

"Shipbuilding in France seems to be languishing in spite of every effort of the Government to bolster up the industry. The French firms of shipbuilders recently made a request to the Government to increase the State bounty paid them for native-built ships, and this request has, we understand, been granted, while no premium will be paid upon vessels bought by French ship owners in Great Britain. The cost of British-built ships is so much lower than French-built ships that it will pay French shipowners to send their orders to this country. The bounty system has hitherto been a failure in France, and there is every reason to suppose that even with the increased bounty it will be impossible to make it a success. The whole system of bounties to particular industries is wrong; it is against the ascertained laws of economics, and must result in disaster to the nation which adopts it."

A late report of the Director of the U. S. Mint shows the gold product of 1892 to be $33,000,000; silver $50,750,000, rated at its purchase value, or $74,989,000 coin value. The purchases of silver, at an average of 87¾ cents per ounce, were $47,394,291. The imports of gold $18,163,056, and the exports $76,736,592. Imports of silver $31,450, exports $37,541,301. In January last the Treasury had, in coin and bullion, $1,243,153,385, and the total in circulation was $1,011,321,753. So the Government had in hand more gold and silver than was in circulation as coin.

If those who want more "money" with which to transact business would give some study to "credit" their fears and hopes would be modified. The Bank of England in its daily business of 22 millions of dollars handles in coin only $2.50 in $1,000. The balances in all clearing houses are made up with less than five per cent. of coin. It is mainly credit, but not the kind of credit commonly supposed. It is not good faith, respectability, or even responsi-

bility, but the assured certificates of actual property. The goods are not passed through the banks and clearing houses, but the "deeds" that represent the goods are. Credit because of responsibility of course enters somewhat into these transactions, and so far as it does rests on the assumption that the creditor has the goods or values ready for delivery. Credit in the abstract does not exist in a banking sense. A veritable saint could not draw for a dollar except upon some assurance it would be returned when wanted or called for. A check of the Rothchilds is good for nothing unless they pay it on demand, neither is an obligation of the Government unless the Government has in hand the actual and convertable property to satisfy such obligations. Abstract credit is a myth.

A civil engineer, in New York, has discovered that the load that one horse can haul on asphaltum pavement equals what two horses can haul on Belgian blocks, five horses on good cobble stones, and seven horses on bad cobble stones. This is curious if true, but how was it found out? Our streets in San Francisco certainly come under the head of bad cobbles, but a horse hauls two tons, sometimes two and a half tons. By the above rule the same horse would haul fourteen to twenty tons on an asphaltum-covered street. The fact is that on cobble stones the wheels are not at all times climbing on stones, part of the time they are descending forward. If the engineer above named will move a wheel vehicle over a corrugated surface when the distance between the front and rear wheels brings one wheel on top and the other between the ridges, he will find cut a new theory of cobbles, but that they are as bad as can be no one will dispute.

The supply of water under high pressure, at 700 pounds per inch, has now reached, in London, about six millions of gallons daily, applied on 1,676 machines of one kind or another, principally elevators. It is only eight years since the first application of the kind, since which time large plants of the same character have been installed at Hull, Liverpool, in Sydney, N. S. W., and elsewhere. This City offers an inviting field for this kind of distribution, which thus far seems to have been considered only in the light of speculating on a franchise, and that is but a small part. "Small" in every sense, because nothing but obstruction. Franchise, bonds, and no investment except by the "other fellow," and his investment mainly in franchise, is the rule. It will soon become impossible to carry out successfully any kind of undertaking here unless this "promoting" business is got rid of. The public are tired of it, and properly so.

The Government has on hand a stock of 9,000 tons of silver, in the purchase of which there has been a loss of about $80,000,000. When the Sherman Law was passed in 1890 the balance of gold in the Treasury, beside the reserve fund of $100,000,000, was $90,000,000. In 1890 silver was worth $1.08 per ounce, and the Sherman Act was to restore its value to $1.29 per ounce, at which point it is in parity with gold, a dollar containing 412½ grains of silver. The result at the end of four years is that silver is worth about 63 cents an ounce, representing as stated a loss of 80 to 100 millions to the country and what gold there is in the Treasury has been clearing out under the "Gresham law."

There has been a dearth of work in Denmark in the engineering trades. The hours worked are ten, and the wages are for moulders $1.00 a day, machine fitters a little less, and still less for plate workers. Laborers get about sixty cents a day. Here is a problem. Any of these men can go in a day to where wages are double as much for nine hours work, and the question is, why do they not go? The answer is, that those men receive all they earn, and their wages would be no more on the Clyde than at Copenhagen, perhaps a good deal less, because of the extra room, tools, delay and expense of superintendance. The statistics of wages that do not include what the wages produce might as well be laid away, and the whole matter be commenced anew. The truth is coming out, and the "law of wages" will before long be made plain, namely that wages are nearly uniform everywhere, if measured by what they produce.

In *Engineering*, London, of March 7th last, is given illustrations and descriptions of a new pier of iron constructed at Salina Cruz for the Tehuantepec Railway. This pier is 900 feet long, reaching water 43 feet deep, and indicates that the company are preparing for permanent business. The National Railway of Tehuantepec, reaching from a port on the Gulf of Mexico called Goatzacoalas to Tehuantepec, then crosses the Isthmus to Salina Cruz. The Mexican Government, which controls this railway, has thus far wisely avoided entangling alliances, and all offers to purchase the line. As a free route it menaces the transcontinental traffic in this country, especially that crossing the Isthmus of Darien, but when one says that traffic is menaced it may not mean any misfortune to the public. The pier above named was designed by Mr. Jonathan Parkman, C. E., of London, and constructed in Belgium.

The Railway Commissioners of New Hampship have raised a query respecting grants for a right of way in streets and roads to electric companies, when the steam-propelled lines have to purchase a right of way and construct their own road beds. The two systems in some cases come into direct competition, and there is certainly something to be considered in such a case. A steam railway to enter this or any other city is not permitted to lay rails in the streets, but must purchase ground, and as the commissioners say, construct a roadbed. The principal fact and asset, to so call it, of any urban line is the ground and right of way, commonly called a "franchise," and as this part is a gift from the public there should be no distinction between different methods of propulsion, except as they are dangerous or objectionable.

It is a curious fact that more shipping passes through the St. Mary Canal, connecting Lakes Huron and Superior, than goes through the Suez Canal. Of course the parallel is not one of equal conditions, but assumed on tonnage, the relative amounts in 1892 were 7,712,028 tons for the Suez and and 10,647,203 for the St. Mary Canal. The number of vessels was 3,559 and 12,580 respectively. Of course the nature and value of what is carried, and the length of the voyages, should enter into what may be called a commercial comparison, but what an idea this imparts of the development of the northwestern section of this country. A commerce scarcely half a century old that requires more than 12,000 vessels to conduct it. The main part is iron ore, and, as before said, the comparison will not hold on other basis than tonnage, but even in that view it is astonishing.

Mr. Carlyle, nearly half a century ago, prophesied as follows respecting the bugbear of "overproduction" in this country:

"The Republic west of us will have its trial period, its darkest of all hours. It is traveling the high road to that direful day. And this scourge will not come amid famine's horrid stride, nor will it come by ordinary punitive judgments. It will come as a hiatus in statecraft, a murder[ous]? bungle in policy. It will be when health is intact, crops abundant and the munificent hand open. Then so called statesmen will cry overproduction, the people will go to the ballot box amid hunger and destitution, but surrounded by the glitter of self rule, and ratify, by their ballots, the monstrous falsehood, overproduction, uttered by mis-statesmen, and vindicated by the same ballot, the infamous lie, overproduction, thrown upon the breeze by servile editors through a corrupt press. And this brings ruin upon his country, serfdom upon himself, and oppression upon his children."

The present combination of copper-producing companies is the first one of an international character that has much affected the price of an useful commodity. Combinations in our country have to be protected by a tariff, otherwise they would be impossible in any case when the consumers can supply themselves from other sources, but when, as in the case of the copper interest, an universal trust is formed, and when the sources of supply are few, there is real danger of a great wrong being perpetrated. There is, in the case of combinations in our country, the means of controlling them by competition from other countries, this, indeed, is the bar that limits the prices that may be fixed for commodities of any kind. This removed there is no bar of any kind.

LITERATURE.

The Technological Quarterly.

This fine publication, for the last quarter of 1892, containing the proceedings of the Society of Arts, Boston, is at hand.

The President of the Institute of Technology, the Hon. Francis A. Walker, occupies the first place with his address on the "Changes of the Year," followed by twelve other articles, all of the high class commonly presented by this journal.

"The Study of Bacteria in Drinking Water," by G. W. Fuller, Bacteriologist of the State Board of Health, Mass. awakens interest in this line of investigation, opening up phases of an organic life, the existence of which was not suspected only a few years ago. It is not assuring to be told that a cubic centimeter of water may contain a million of living, moving organisms. It may mollify one's conscience in the matter of swallowing raw and living oysters, but even this is a questionable proceeding.

A paper on "Heating and Working Metals by Electricity," by Mr. Geo. D. Burton, the president of an electric forging company in Boston, shows that this method of heating, when properly managed, is cheaper than by fire, while other advantages are such as to scarcely permit comparison. The heat is applied from the center of the pieces outward; they can be heated only where required, and heated during working, so no time is lost; there is no sulphur or other minerals absorbed and no oxidation; the work is always in sight and never burned; the temperature can be regulated at will; there is no smoke, heat or soot to contend with. The whole process is clean, exact and rapid—is wonderful, indeed.

Journal of the Franklin Institute.

JUNE, 1893.

In this number of the Journal is given Prof. C. F. Himes' lecture on the "Scientific Expert in Forensic Procedure," which is in essence an educated attack upon expert evidence, and as we, with all due respect, must claim, is in many respects a misunderstanding of it.

Nothing is more natural than for a lawyer dealing with and educated in the most indeterminate of all things—the law—to be at variance with and jealous of evidence and everything else that deals with what we call science, or is capable of establishment by immutable authority.

Scientific expert evidence we will venture to claim is more exact and conscientiously given than any other, if we exclude that portion which relates to special or empirical as distinguished from scientific knowledge, and the fault found with it is that such evidence is commonly on "one side," that is, the witness testifies to facts that go to support his client's cause the same as the lawyers do in framing their briefs and arguments, but the educated expert sticks to the truth so far as it is known to him, but not being a witness of the court as he ought to be, but of one side, there is no obligation to give more truth than assists his client's cause.

Putting it on ethical grounds and confining the comparison to engineers, from which profession experts are most commonly drawn, it will be an answer to some portion of Professor Himes' lecture to say that the standing of engineers compared with lawyers should have some bearing on the matter discussed.

We do not want to draw invidious comparisons, but if any engineer expert were to descend to the methods of lawyers he would be kicked out of the profession.

The technical phases of the subject we have no space to discuss further than to say that expert evidence for a client called by one side is all wrong, derogatory to the standing of any scientific man and is commonly shunned by them unless to demonstrate some specific truth without reference to the issue of a case.

There is no difficulty in expert evidence in Forensic Procedure when the subject matter dealt with lies within what may be called scientific grounds, but it is in the field of empiricism that the difficulty begins. Lawyers cannot well distinguish between the two, and as there are no determinate standards in their own profession, their views of such evidence is that it consists of opinions only.

A lawyer is himself an expert, and his relations to a client not different from those of technical expert, in fact, it is not uncommon for a lawyer to do no more than present and argue a brief, the substance of which has been prepared by a technical expert. In patent cases, for example, the legal procedure is often a secondary matter—one of routine—while the whole case rests upon what Professor Himes calls "expert evidence."

The Slide Rule.

This treatise, by Mr. William Cox, C.E., the Editor of the *Compass*, is in a line of subjects of which Mr. Cox is an authority—what may be called mechanical computation, by means of apparatus based on the well-known logarithmic laws of mathematics.

Among such implements or apparatus the slide rule is chief. Its true usefulness will, however, never appear until it is taught as a branch of common education.

Mr. Cox remarks in his introduction:

"The construction of the slide rule is based upon logarithms, but the principles which require mastering are few and simple, and a little attention to the following observations will enable any one to understand them. Each step of the ladder once firmly gained will then become, not only an incentive, but an opening up of the way to mount higher, by showing the logical consequences of the knowledge already acquired."

On this coast a good many civil engineers employ the slide rule constantly, and with an immense saving of time and effort, also with a freedom from lapses and errors that are apt to creep into free computations.

The instructions given in the present treatise fully comprehend the use of the Manheim and Duplex slide rules, and the examples given, of which there are more than a hundred, renders the various operations clear.

The author's familiarity with the subject of graphic computation, it may be called, in some other of his writings causes him to forget the elementary conception of a beginner, but this does not apply in the present case, which is the best example of lucid instruction that can be referred to.

The Duplex slide rule invented and patented by the author, while based upon the same scales as the Manheim rule, has much wider functions and with no more complexity when once the system is understood. This rule is provided with slides on both sides or faces, consequently requires one half as much shifting, or in other words, when two or more positions are required the preceding one can stand until the next is made and compared, a great convenience and safeguard against error.

The Manheim slide rule is now made with white and black surfaces or scales so as to be more clearly read, and is furnished with a book of instructions for $6.50. The present book, containing three parts, is sold for 75 cents, by the Keuffel and Esser Co., New York.

The Sibley Journal of Engineering.

Published by the students of the Cornell University, comes to hand for June in an improved dress throughout.

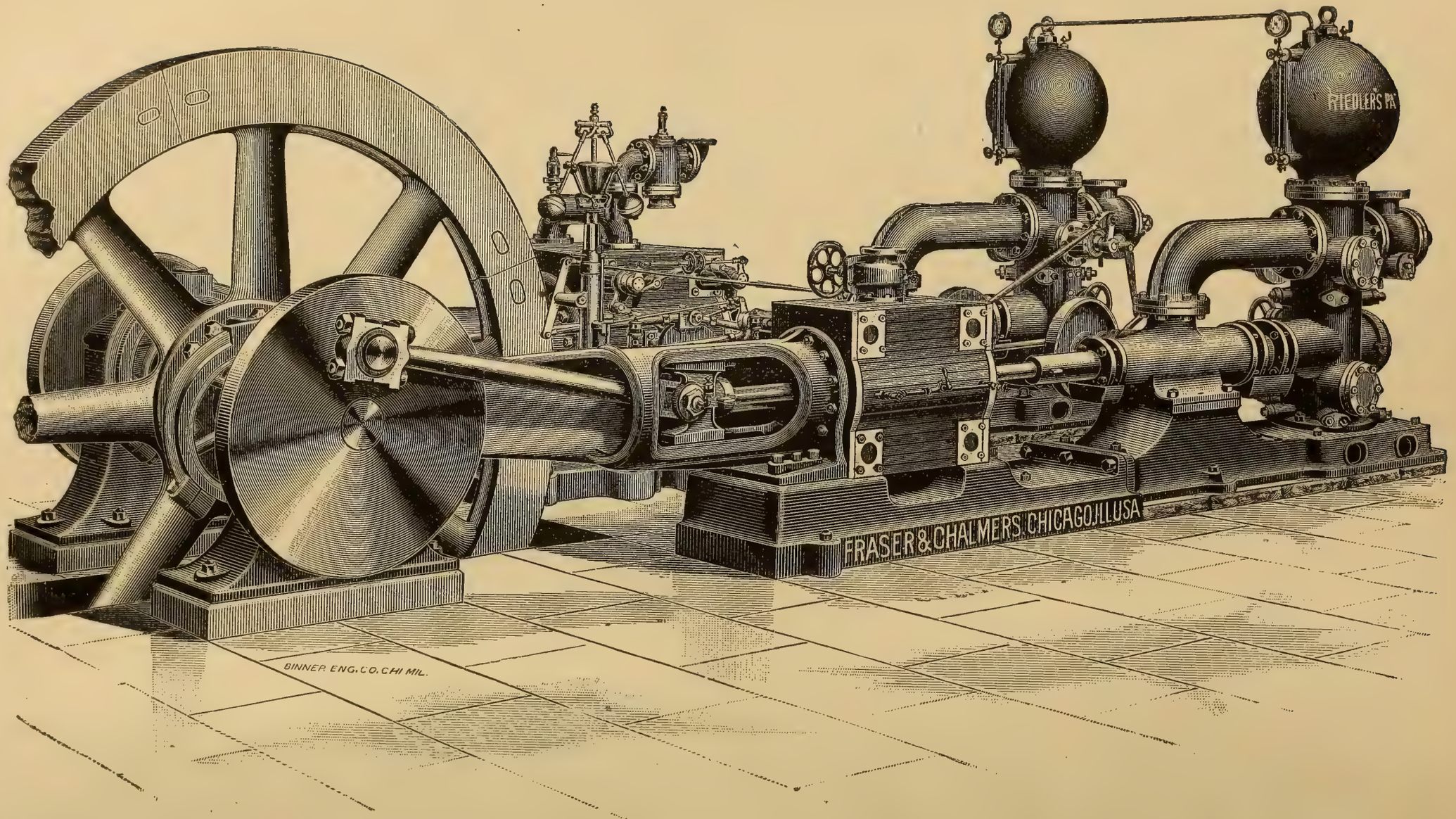
It contains a short biography of Hiram Sibley, the founder of the college that bears his name, with various other papers of interest, among them a report of a test made with the water works engines at North Point Station, Milwaukee, Wis., by Prof. R. C. Carpenter. These engines, by the Allis Company, of that city, are steeple framed inverted triple engines of 557 horse power. The duty rated in the usual terms was nearly 127,000,000, and the consumption of coal only 1.38 lbs. per horse power per hour, and the consumption of feed water 12.15 lbs. Other articles are of the usual merit, indicating a wide curriculum in the College of Mechanics, at Cornell University.

The Labor Gazette.

We are favored by copies of this publication from the Labor Department of the Board of Trade in England, a monthly publication occupied mainly, or indeed wholly, by statistics and labor news at home and abroad.

We are at some loss to know the particular object of this journal as a Government document, and will venture the prediction that it will not prevent, but on the contrary will promote, what we call labor disturbance, by giving the subject such prominence.

The statistics will not, do any harm, *per se*, indeed, are necessary in order to secure wise governmental action, by laws or otherwise, in the matter of strikes and disturbance, but do not require serial publication, for this purpose.



Riedler Pumping Engine.—Fraser & Chalmers, Chicago.

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"INDUSTRY."

JOHN RICHARDS, EDITOR.

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RIEDLER PUMPING ENGINE.

FRASER & CHALMERS, CHICAGO.

We need hardly remind our readers of the many times, during two years past, this Journal has called attention to the improvements in pumping apparatus introduced by Professor Riedler, of Berlin, Germany; also by others, who, during the same time, have been attempting improvements in the same line. His great work on this subject, *Indikatur Versuche aus Pumpen*, was given out to the world about five years ago, and has since been followed with other writings of his that should have commanded a great deal of attention on this Coast, but has not done so this far, until now these improvements will, no doubt, reach us through means that prevent or limit their manufacture here.

Prof. Riedler was engaged for many years in "finding out what took place inside of common water pumps," and discovered forces set up there that no one had previously suspected. In his *Versuche aus Pumpen* are diagrams of internal pressures that surpass belief, taken it is true in many cases from pumps that rank below practice on this Coast, still the results here with pumps having water-moved valves would not be much different.

Professor Riedler's improvements are of a simple nature, and relate mainly to two things, eliminating valve resistance and disturbance of the water in its course through the pump, and in maintaining throughout all the water ducts uniform, or nearly uniform,

velocity of flow, and with as little change of direction as possible. By these improvements the economic efficiency of pumps has been a good deal increased, but the main gain has been in capacity, which may be set down at not less than one hundred per cent. if comparison is made with average performance.

The valves of the Riedler pumps open automatically, but not against springs, and only for a short distance, so as to close quickly. They open wide immediately when the stroke begins, and are closed by positive gearing at the end of the stroke, the same as the valves of a steam engine are, without shock and at the precise point required. This will be understood from the drawing in the frontispiece, which shows a pumping engine made for the Boston and Montana Mining Company, at Butte, Montana.

The steam cylinders are compound, 16 and 25 inches diameter, 24 inches stroke, steam jacketed all over. The pump plungers are differential, one being 5⅝ inches and the other 8 inches diameter, operating like a bucket-plunger pump, so that only one set of valves are required. The engines are set at a distance of 700 feet from the boilers, and perform a duty of 100,000 foot pounds for each pound of feed water consumed, and raise 900 gallons per minute against a head of 600 feet.

On the outward stroke the displacement is an annulus of water in the first or smallest barrel equal to the difference of volume of the two plungers. On the inward stroke the rear plunger sends one half of its displacement up the discharge way, and one half into the front or smaller pump. This will be understood from the drawing. The valve gearing is very simple, consisting of a crank and motion rod, as can be seen on the second pump.

The gain in capacity over the common type of pumps of slow speed, with water-moved valves, is indicated in this case by other tenders made for this same duty. Taking the smallest engine tendered for in competition, the steam piston area in the two cases was as 1665.5 to 692.8, or as 2½ to 1. The cubic contents of the steam cylinders was as 69,951 to 16,627, or as 4½ to 1 ; in other words, the Riedler engines require to be about one third as large for the same duty. The piston speed is not given in the particulars furnished by the makers, but is, of course, in the same proportion, less something perhaps for higher efficiency.

Messrs. Fraser & Chalmers are just now developing the Riedler system as applied to air compressing. Our readers, most of them, will know that Prof. Riedler was associated as a consulting engineer in the construction of the 8,000 horse-power addition to the Paris

Pneumatic Company's plant, recently made. The four great engines of 2,000 horse power each were made in accordance with his designs and improvements. The gain claimed over the older plants seems incredible, being in some reports 2½ to 1.

The fact is that just now when we have been comfortably assuming that pumping at least is nearly perfect, we are on the eve of improvements, that will most likely change in a material way all kinds of practice in this direction.

THE KATAHDIN.

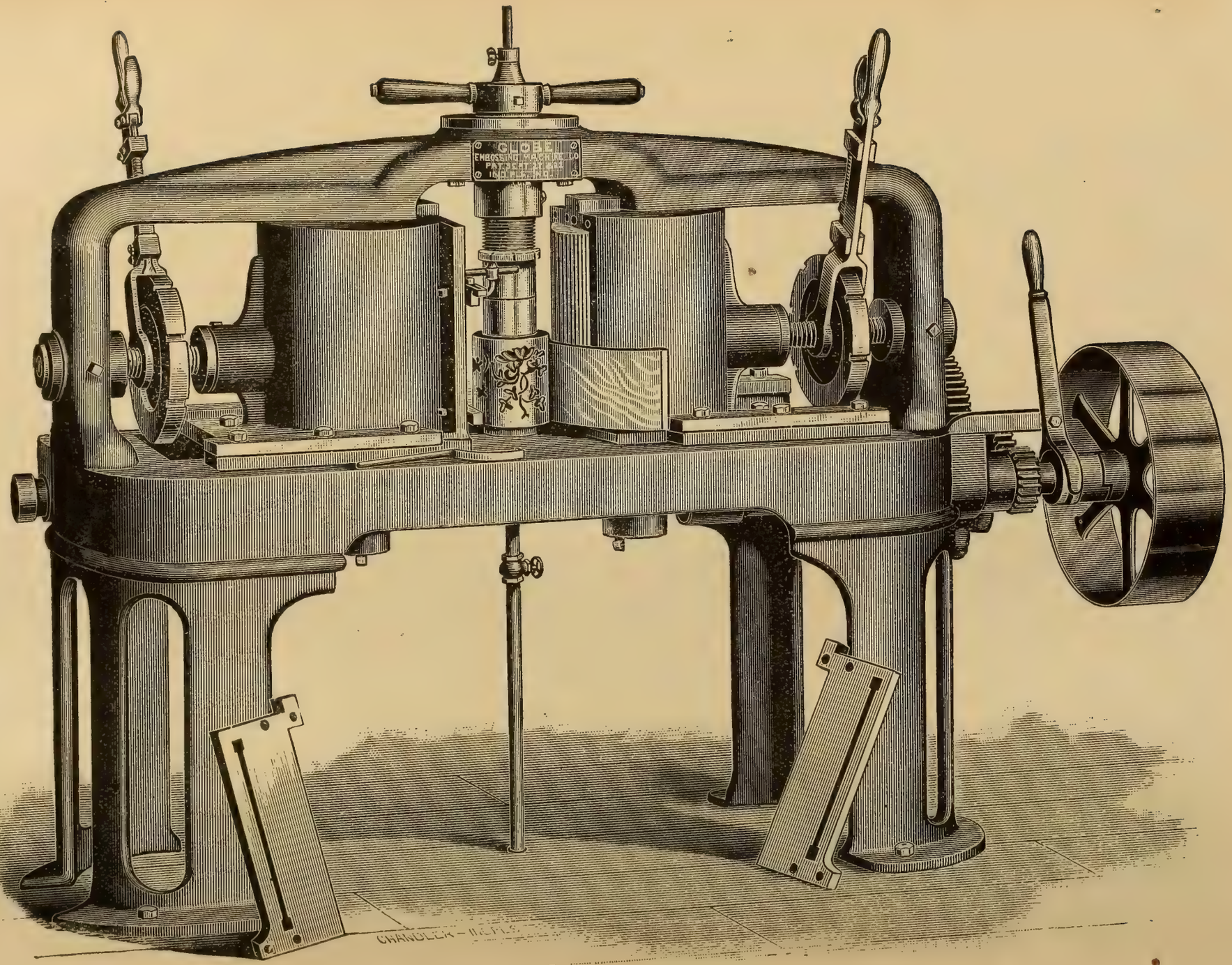
It is possible, and even probable, that Admiral Ammen has produced in the *Katahdin* a whole navy, or what is equal to one, in so far as destruction. It is easy to remember what took place when the old *Merrimac* was roofed over with railway bars and sent out among the wooden fleet in Hampton Roads thirty years ago. It was merely a matter of the old frigates waiting their turn to be sunk or cut to pieces, until the appearance of Ericsson's "cheese box on a raft," and it is possible that the appearance of the *Katahdin* among a modern fleet would operate in a similar manner.

"Ramming" is not a new art in naval warfare, but this far there has been no ships designed as this one is, every feature being tributary to that object, and the vessel if not absolutely impregnable to shot is as nearly so as engineering skill can provide, and in this latter lies the principal element of Admiral Ammen's design.

He has the advantage of Mr. Farwell, of Illinois, the member of Congress who proposed to help out the Navy Department with certain ideas evolved upon the Western plains, where irrigation apparatus would be better understood. The Admiral has had considerable experience in operating rams, also the advantage of naval training, and a scientific education, all of which are important if not essential qualifications in the successful designing of war vessels.

In the *Katahdin* the angles presented to shot are such that penetration is impossible, at the same time is secured wonderful stability, with a submerged section that will possibly permit the vessel to yield laterally without being sunk, if she herself was rammed on the side.

The *Katahdin* is 251 feet in length, 43.5 feet beam, and is built with 72 water-tight compartments. The outlook tower is 18 inches thick. The speed 18 to 20 miles an hour. The cost of the ship is about one million of dollars, and she is just now ready for business, and waiting for some one to "disturb the peace."

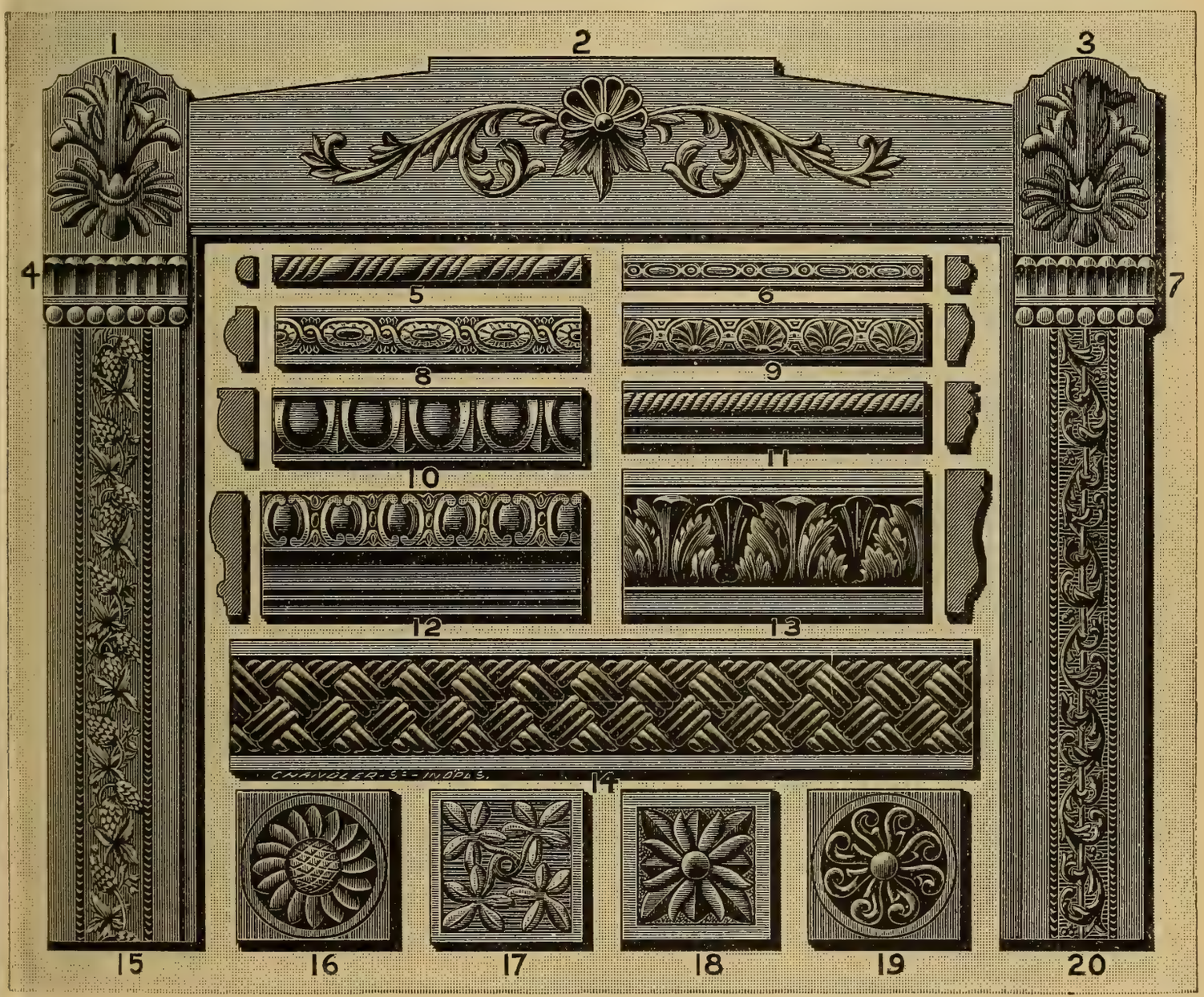


WOOD-EMBOSSING MACHINE.— GLOBE EMBOSSING MACHINE CO., INDIANAPOLIS, IND. FIG. 1.

WOOD-EMBOSSING MACHINERY.

THE GLOBE EMBOSSING-MACHINE CO., INDIANAPOLIS, IND.

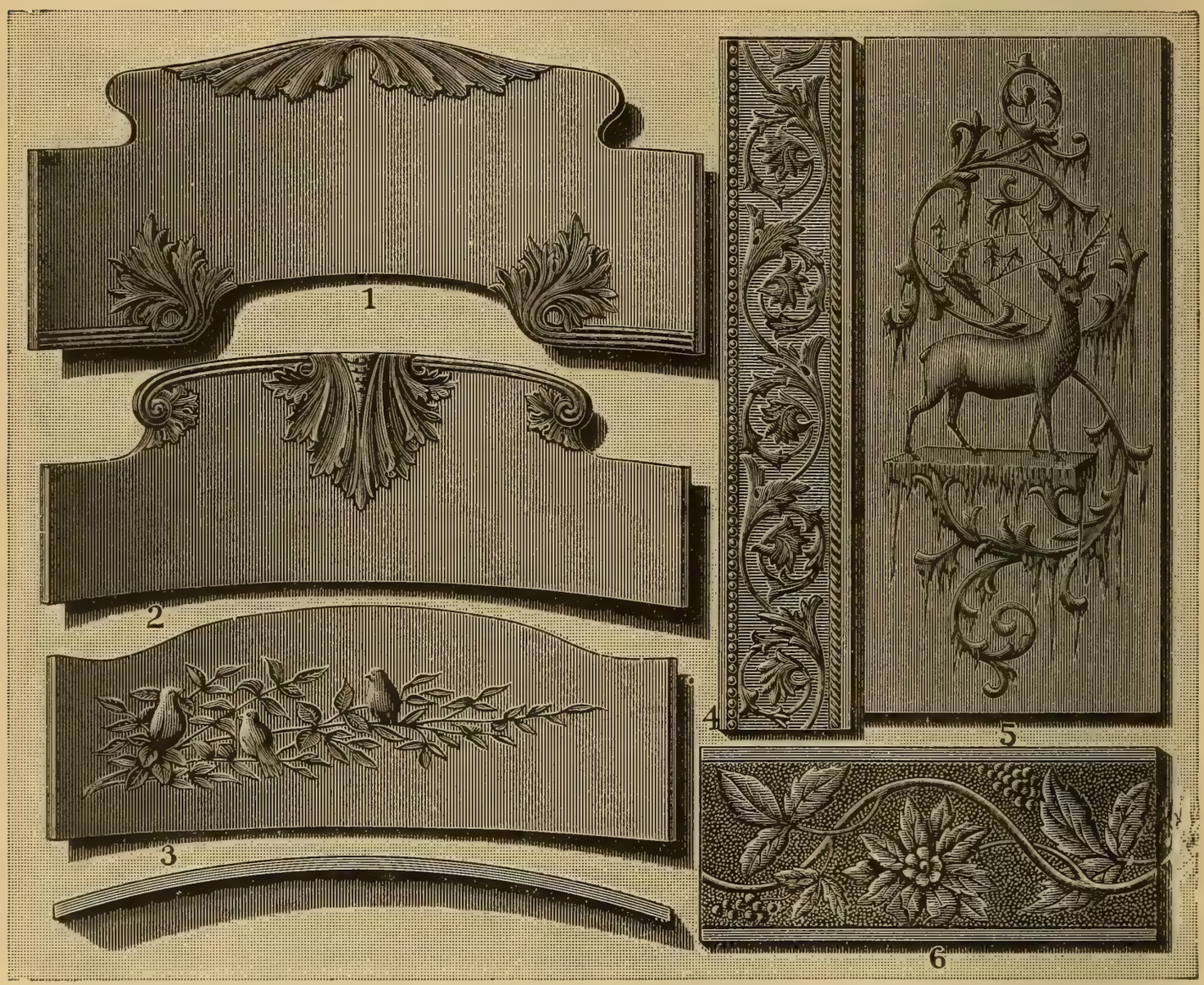
The Company above named have done a wise thing in producing some very complete and serviceable machines for wood embossing, one of which is illustrated on the opposite page. The machine



EXAMPLES OF EMBOSSED WOOD. FIG. 2.

shown is a double one, so arranged that both sides of the embossing rollers can be used at one time, and two pieces pass through the machine simultaneously. Single machines are also made, as will be explained further on.

It is a great wonder that so little wood embossing is done. In an artistic sense it is a kind of ornamentation that is pleasing and permanent, infinitely better than cheap coloring that takes its place. It is quite as pleasing as carving, much more accurate, better finished, and free from the objection of collecting dirt, also is cheaper in a degree that almost prevents comparison.



EXAMPLES OF EMBOSSED WOOD. FIG. 3.

The process is very simple after the matrix, relief, or figure is once engraved on the embossing rollers. The remainder consists in simply pressing the rollers when heated to a limited degree, down into the face of the wood, or, to be more exact, pressing the wood into the engraved figures on the rollers.

The machines for this purpose consist essentially of a hollow spindle, on which the figured rollers are mounted, and a feeding rol-

ler that presses the wood against the embossing one, with mechanism to cause and regulate the pressure, also to revolve and heat the rollers.

In the present machines a main feature, outside of very complete and symmetrical design, is that the rollers are set vertical so the flame or hot gases to heat the dies or rollers will rise automatically through the axis, which is made hollow for that purpose. The heat can be produced by any of the hydro-carbon oils, or by flame of any kind led into the interior of the roller spindle, as indicated by the pipe in Fig. 1.

Figures 2 and 3 show specimens of embossed work done on these machines. The relief is quite enough to produce reflection and distinctness of the figures, and the designs can be varied to meet all tastes. The hard woods of this Coast, and south of here, especially Mexican woods, are of a nature suited for embossing, and a "plant" here would, no doubt, find successful employment.

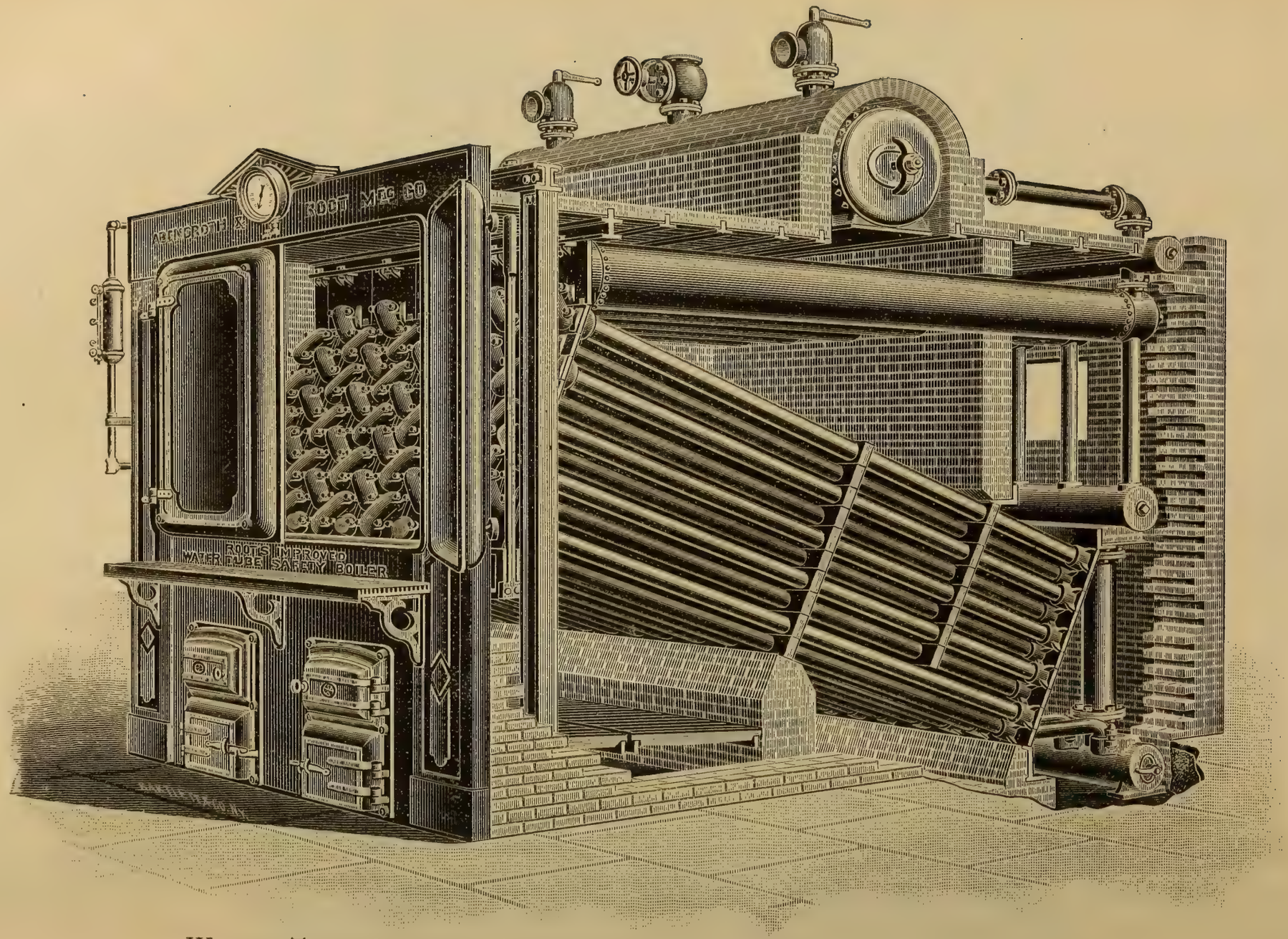
WATER-TUBE BOILERS.

THE ABENDROTH & ROOT MANUFACTURING CO. NEW YORK.

The early history of water-tube and sectional boilers in this country, and in all countries, is one of trials and persecution. The operative conditions of such boilers were obscure and not known. Methods of fastening or making joints were not developed as they are at this day. The whole art had to be generated, so to speak.

We can well mind when Joseph Harrison, Junior, after completing the Moscow and St. Petersburg Railway, and the great bridge across the Neva, at St. Petersburg, in Russia, came home to Philadelphia, the richest man in that old city, entered his name in the directory as "Joseph Harrison, Junior, Blacksmith," and began making at Gray's Ferry, in the southern end of the city, sectional boilers of cast iron. He had faith and money; went to England and had Sir Joseph Whitworth & Co. make for him expensive machines to mill the nipples on the cast iron globes or cells of which his boilers were composed. This was thirty years or more ago. The boilers are made yet, and as we believe successfully.

Not so very long after this when wandering about in New York one day we stumbled upon the "Root Boiler Works" and concluded that the methods there were a second stage in the evolution of sectional boilers. It proved to be nearly a final one, because the boiler



WATER-TUBE BOILERS.—THE ABENDROTH & ROOT M'F'G CO., NEW YORK.

shown on the opposite page has all the main characteristics of the first and also the last types, improved no doubt in many ways, or perhaps in all ways, but the main part remains.

The inclined tubes which causes the course of the gases of combustion and the flow of the circulated water to cross each other in their course, the highest part of the tubes and the hottest steam in the hottest part of the furnace, the deposition of sediment in the coolest end, remain now as then, the chief characteristics of the best water-tube practice.

The battle of the water-tube boilers went on with varying success until the era of high expansion set in, then came high pressure and this settled the sectional boiler problem. They filled a new want and settled down as a permanent element in modern steam power.

Following these remarks with a bold assumption, one may claim after looking over boiler history for the last thirty years, that it would be a blessing if the world could be supplied with three types of boilers—the best of each—the sectional or water-tube, Cornish or Lancashire, and Scotch marine. We have too many kinds of boilers, and have not made progress in proportion to modification.

The Abendroth & Root Company construct their own boilers, which by reason of being made up of units and duplicate parts have been reduced to a systematic "manufacture" the main elements interchangeable and so made that the units of the system can be combined or divided to meet the varied requirements of capacity from a common stock of prepared parts.

The drawing does not require explanation for steam engineers, who are all more or less acquainted with boilers of this type, and we will only mention a very complete circular or catalogue published by the Company, written in the third person, a commendable fact worthy of mention, giving careful description of all that pertains to the water-tube system, but too extensive for further mention here. We note respecting the area of chimneys, on page 35 of the circular, the following rule :

$$C = \frac{201}{\sqrt{H - 8}}$$

C being the area of the chimney flue in inches required for each square foot of grate surface, H the height of the chimney in feet above the grates. The other quantities are constants. The formula if written with a factor representing grate surface would be more convenient, but tables are made out for reference.

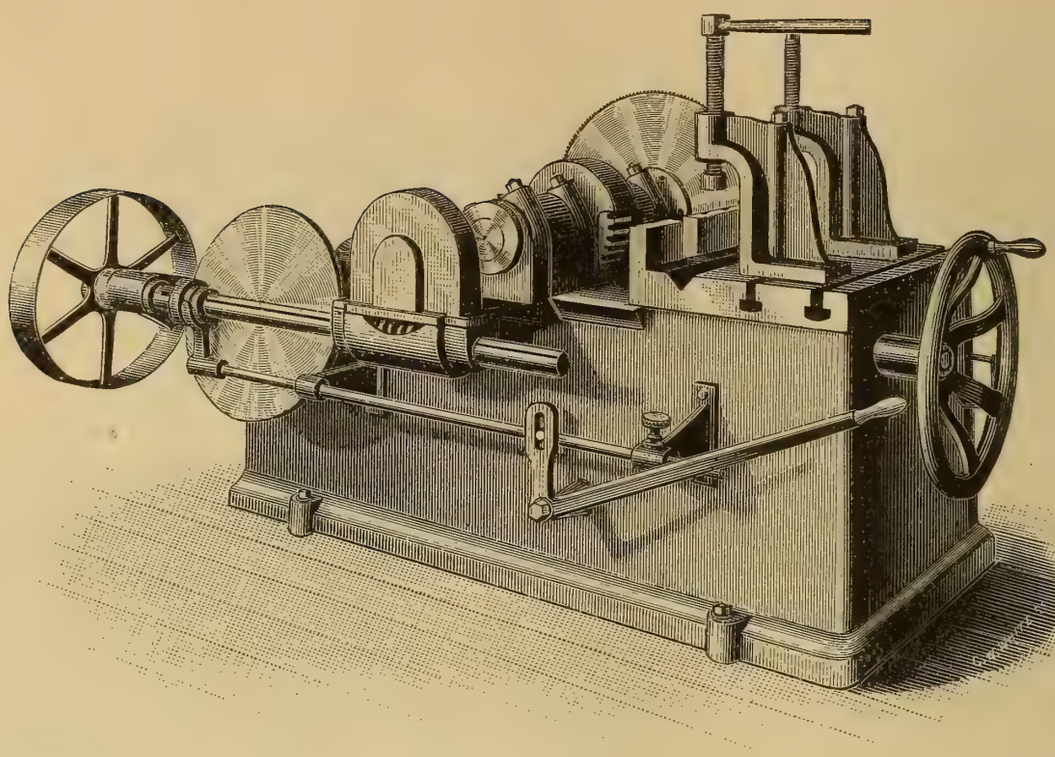


FIG. 1.

METAL-SAWING MACHINES.

NEWTON MACHINE-TOOL WORKS, PHILADELPHIA.

In our last issue mention was made of the very thorough manner in which the manufacture of cold-sawing machines for metal had been taken up in this country, tardily it must be admitted, because, for a wonder, such machines were extensively used, and their merits fully demonstrated in Europe several years before they were introduced here.

This is not uncommon, and perhaps to be expected. It is true of various processes in wood and iron conversion, and in other manufactures, and in respect to various countries, but it is seldom that we are behind in this country with any improvement of real merit, in the way of tools at least.

It is a wonder, if we consider "milling" in the abstract, that it was not sooner and more widely applied to cutting off metal sections. It has a peculiar adaptation to this particular process, and was applied more extensively in this country than anywhere else to the displacement of considerable sections in producing shapes or profiles. Not only this, the makers of twist drills in the Eastern states have, for many years past, and long before these cold saws became regular shop machines, employed similar saws to cut lengths for drills from cast steel rods, one of the most difficult kinds of work for cold saws.

The Newton Machine-Tool Works, ever since they were founded, have given a good deal of attention to special machines, and have produced a great many successful designs that have been characterized by high skill and successful adaptation to purpose. It is not singular, therefore, that they should take up cold sawing, and produce a system of machines for that purpose, which seem to be a good deal in advance of European practice.

Cold cutting-off machines consist essentially of a strong, well-fitted saw spindle driven by spur or other gearing, the last mover on the saw spindle being as small as possible, because the diameter or size of the pieces cut cannot be more than the difference in radius between the driving wheels on the spindles and the saws. The saws have fine teeth, and are, as before mentioned, large thin milling tools, the bottom edge of which run in a pool of oil or soda and water, soap it may be called.

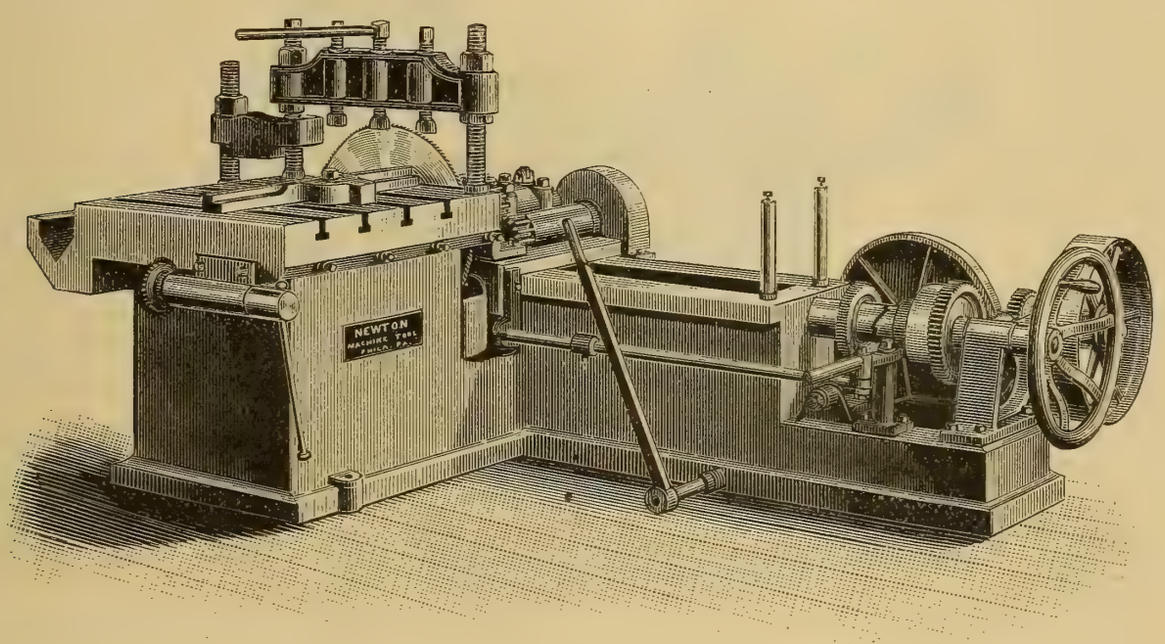


FIG. 2.

The machine shown in Fig. 1, at the beginning of this article, is a standard one, made of five sizes, to cut off round or square bars of steel or iron from 3½ to 12 inches in diameter or thickness, the saws being from 12½ to 36 inches diameter. The pieces are held under the screw clamps in front, on a movable table that is fed slowly forward by means of variable gearing that can be adjusted to suit the hardness of the material. The feed is not changed by stages, but is graduated to any degree by the mechanism seen in front. The saw spindle on this machine is stationary, or has no lateral movement.

Fig. 2 shows a more elaborate machine, in which the saw is traversed for the feed movement, thus adapting the machine for cut-

ting off flat bars or plates as well as square or round sections. The saws are 24 inches diameter, and the range of the saw will cut pieces to 24 inches wide, also round or square bars the same as in Fig. 1, the **V** clamp seen at the side being for that purpose.

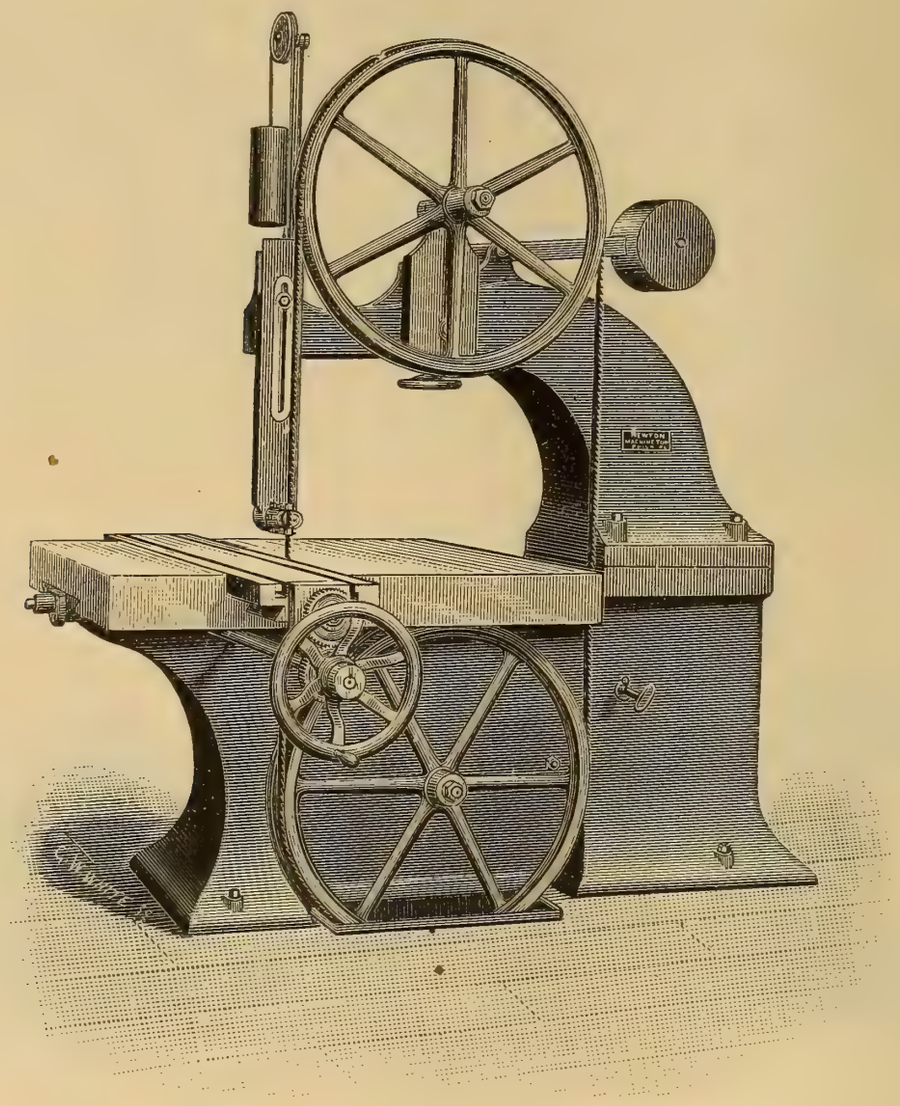


FIG. 3.

Fig. 3 shows a metal-cutting band saw by the same makers. This is another machine much less employed in this country than it should be. It is used mainly for square cutting, that is, where the kerf is required to stop at a right angle with the table, as in cutting out crank slots, also to some extent in cutting curved or irregular lines.

In England the side frames of locomotives are cut out in this manner, a number of them being laid up in a pile and sawed out together, consequently being exact duplicates for each side of an engine. The most extensive use we have seen of such band-sawing machines is in the gun-carriage department of Sir William Armstrong's Works, at New Castle, England, where the framing plates

are sawn out with great precision, the edges requiring only light filing to finish them; also the test pieces that have to be cut from each principal piece for the rifle guns made at these works.

The Newton Machine-Tool Works publish a special circular of sixty pages, giving full information respecting cold-sawing machines and processes.

PETROLEUM IN STEAM BOILERS.*

BY W. A. DOBLE, M. E.

It is not the object of this paper to cross swords with the manufacturers or sales agents of any boiler compound, neither does it recommend or condemn any. Its sole object is to bring before the Society, an account of the use of coal oil as a boiler scale preventive by our company.

We will not treat this subject from a scientific standpoint, and will not attempt to deal with the chemical action of the various resolvents on the lime, etc., in the water, nor their effect on the material of which the boiler is constructed, but will merely relate our experience with it as an ordinary practical shop experiment covering a period of over six years.

We use a plain tubular boiler, 44 inches diameter, 14 feet long, with thirty-eight 3-inch tubes, and a grate surface of 16 square feet. It generates steam for a ten-hundred-weight steam hammer, and also a vertical engine coupled direct to a forging press. We consume on an average 2,000 pounds Wellington screenings per day of ten hours; this includes the coal used in banking the fire over night. We wash out the boiler every two weeks, and bank the fire over the intervening Sunday.

About the year 1886 or 1887 we noticed in one of the technical papers an account of an experiment tried on the boiler of an eastern municipal pumping station, of using coal oil as a scale preventive, where they had been bothered with a very hard scale which clogged the tubes, it being a water-tube boiler. As we remember it, the first experiment was to find if the coal oil would stay in the water any length of time, the general belief being that it would evaporate rapidly with the steam. A little coal oil was put in a large test tube partially filled with water, and the tube placed over an alcohol lamp. The heat caused the water to boil violently, and the globules of oil circulated round with the water, and could be distinctly seen.

*Communication to the Technical Society, Aug. 4, 1893. Reprinted by permission.

Of course some of the oil did evaporate, but the greater part remained in the water. The actual test was so successful that we concluded to try it, as our experience with the compound we were then using was not satisfactory.

Our method is as follows: When we wash out the boiler and refill it we put in two quarts of the cheapest coal oil that we can buy, generally about 110° fire test. Below the suction pipe of our injector, and connected with it by means of a **T** and two cocks, we have a well, the capacity of which is about a quart. In about three or four days we fill this well with the oil, and the feed water passing over the connection gradually displaces the oil and carries it into the boiler, usually taking three to four hours to displace all of the oil. In about three or four days we repeat the quantity, using in all about one gallon of oil to each run. This includes the two quarts placed in the boiler after being hosed out.

Before we tried the oil we were using a well-known scale resolvent, and in the language of the firemen "the boiler was as clean as new, because the scale was not so thick but that we could count the rivet heads." Of course the bottom sheet of the boiler was comparatively clean where you could get at it to hack the scales off, but up among the tubes, and on the shell of the boiler back of the tubes, and on the tube heads, the scale was very thick and hard. Since we have used the oil we have not found it necessary to use any mechanical means to keep the tubes and tube heads in order. Of course the oil does not prevent the precipitation of the lime that is in the water, but it is in the form of loose scales and does not adhere to the iron. Usually it collects on the crown sheet in a little scattered pile, just as it would gradually settle while the circulation of the water became less and less as the fires cooled down.

The tubes, shell, and tube sheet are practically clean and without any scale whatever. Sometimes there will be a little particle of thin scale, but the next time we clean out that collection of scale will be gone, and maybe a little collection will have settled on another spot, but it is always thin, not over $\frac{1}{32}$ in., and is loose and can readily be picked off with the thumb nail. Our boiler is now over eight years old, and we have not put any repairs on it other than to put in new grate bars and fire-door liners. The duty is heavy, as the steam hammer is a very irregular consumer of steam, and the vibration and concussion is severe on the pipes, settings and connections, so that we consider this a very fair record. Will say also that there is no pitting or corroding, but the plates are clean and bright.

ENGINEERING PAPERS AT CHICAGO.

Through the courtesy of Professor F. R. Hutton, Secretary of the American Society of Mechanical Engineers, we have been favored with advance copies of the papers presented to Section B of the Engineers' Congress, held in Chicago in July. We cannot do much more than to mention the matter. The large number of papers, and the wonderful diversity of subjects, precludes even a list of them.

One of the most novel is that of Mr. Thomas H. Brigg, of Bradford, England, on "Haulage by Horses," and commendable too, because it is the treatment of common and widely-known subjects that no one has ever considered worth investigating. The author in speaking of his theme says: "Although it may relate to the common draught of a horse, it embodies principles which have never yet been practically applied, and principles which no man need be ashamed to understand."

Mr. Charles T. Porter's paper on the "Limitation of Engine Speed" presents, we think, but little modification of his views twenty years ago, and an inference is that he has, in all this time, not departed much from his views on engine speed.

Mr. F. H. Daniels contributes an interesting paper on "Wire-Rod Rolling," well illustrated, compendious and well written.

A paper on the "Operation of Centrifugal Machines," by Mr. Gustav Hermann, of Aachen, Germany, is a good example of practical analysis, and treats upon a subject very imperfectly understood.

The papers by American engineers, many of them, relate to steam and motive power, and indicate the wonderful amount of attention and progress in that art made in this country during the last few years.

The titles, which are an important part of technical papers, are mostly well chosen, in some cases however are faulty. For example, "The Refrigerating Machine of To-day," by Mr. C. Linde, of Munich, Germany. We cannot help thinking the translator has tinkered with the title, because this is not a German expression. It is not "the" machine, but "machines" that are meant, and not of "to-day" but of the present time. Such titles mar a paper to which they are affixed.

AWARDS AT CHICAGO.

It is to be trusted that the management of the Exposition at Chicago will adhere to their decision to not grant medals for comparative merit. This whole scheme is a childish idea, born of large pigs and pumpkins at country fairs, and wholly undignified in connection with the exhibits at a "World's Fair."

The first premiums naturally go to the greatest firms with most resources, and consequently to those who least need such awards; besides, there is no assurance in the decisions being right, if even that were possible. The public are the real judges, and it is their good opinion that is sought, and which alone can have much value. Judges and juries are influenced by various circumstances other than the real merit of exhibits, and it is hard to imagine any conscientious and fair person accepting such an onerous and awkward position as that of a judge in such cases.

The most remarkable, and at the same time valuable award we have ever known of was at an exhibition of the Franklin Institute, held in Philadelphia, when the judges of a class of machinery requested one firm to withdraw their exhibit from competition, because it so surpassed the rest that no fair award could be made under the circumstances.

The case at Philadelphia was in the class of wood-working machinery, and the exhibit withdrawn from competition was strictly within the classification as to name, but entirely without the class in so far as the purposes of other exhibits, being for railway and ship building mainly, while the other exhibits in the class were for joiner and cabinet work. This case we mention as an illustration of what will occur in a good many cases at Chicago, where classification will not serve the purpose of fair awards, even if judges were competent to determine quality.

For further illustration, suppose that Mr. B. D. Whitney, of Winchendon, Mass., whom we mentioned in a recent article, had exhibited his machines in the wood-working class. The workmanship would probably not be excelled by metal machine tools of the highest class, and on this ground a jury or judge would have been compelled to award a first prize, while the machines nearly all being peculiar and special, are really not in competition, in so far as functions, with other makers in this country.

For these and many more reasons, competitive awards, to be fair,

can only be made on subdivisions, and not then unless there is a farther distinction between the workmanship and efficiency of implements. The former is apparent, the second seldom capable of demonstration at an exhibition.

A "report" on classes of machinery or other exhibits, which would convey the opinions of skilled judges, would perhaps be the fairest manner of dealing with the matter, but even this does not compare with the unrendered views of the public, which is after all the real authority appealed to.

NOTES ON ARTESIAN WATER

AND THE

EFFECT OF IRRIGATION ON SUBSURFACE WATER IN THE SAN JOAQUIN VALLEY, CALIFORNIA.*

BY C. E. GRUNSKY, C. E.

San Joaquin Valley is 250 miles long, and about 50 miles wide. The mountain ranges between which it lies are nearly parallel. The western slope of the Sierra Nevada Mountains, toward the valley, is 50 to 80 miles long. The eastern slope of the Coast Range is generally but 5 to 10 miles in length. More detritus has been swept into the valley from the long slope of the Sierra Nevada than from the short slope of the Coast Range, consequently the present trough of the valley lies much nearer to the base of the Coast Range than to that of the Sierra Nevada.

The valley, where it opens out toward the outlet through the Coast Range, has not yet been built up to the height of high tide in the ocean. Nearly 500 square miles of its surface at this point are almost absolutely level, thence land rises very gradually in the direction up the valley, but more rapidly toward the base of the mountains from points at the edges of the valley's trough. The lands rise faster toward the Coast Range than toward the Sierra Nevada.

In round numbers the general elevation of valley lands at the head of the valley is 400 feet above the sea, it is 200 feet near Tulare Lake, it is 400 feet at the base of the Sierra Nevada directly opposite this lake. It is the same at the base of the Coast Range northwest of the lake, it is about 300 feet at Fresno, 150 feet in the

*Extracts from a paper read before the Technical Society of the Pacific Coast, San Francisco, August 4th, 1893. Republished by permission.

Stratification of San Joaquin Valley.

Fig.1.

Section from NE to SW, through Tulare Lake.

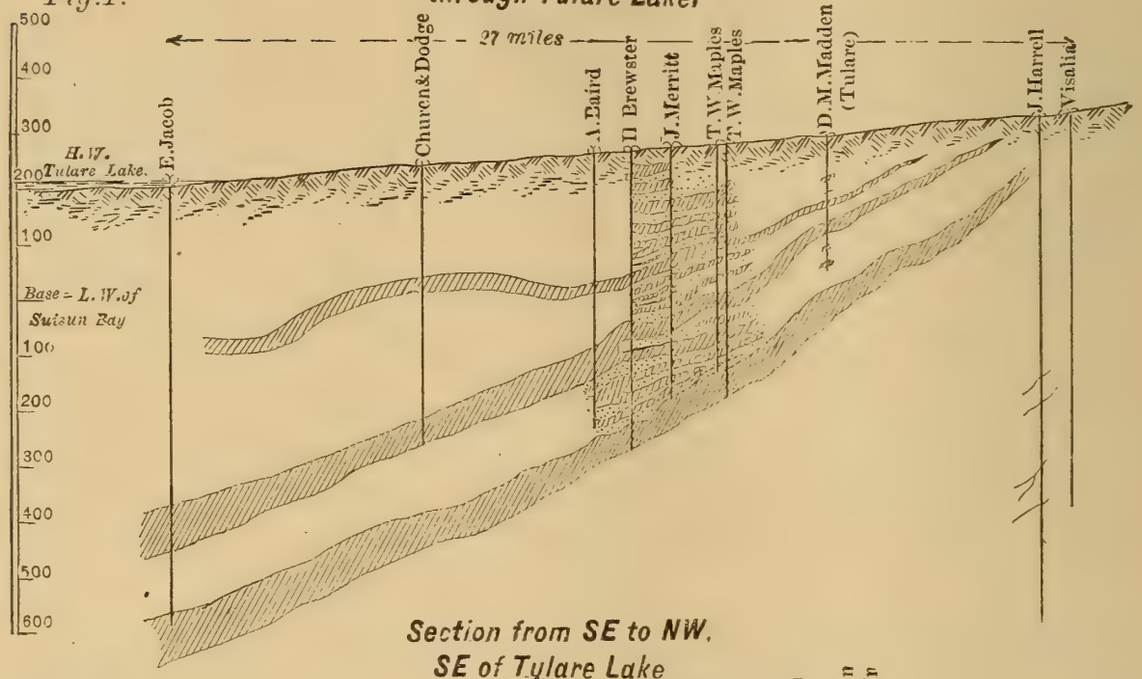


Fig.2.

Section from SE to NW, SE of Tulare Lake

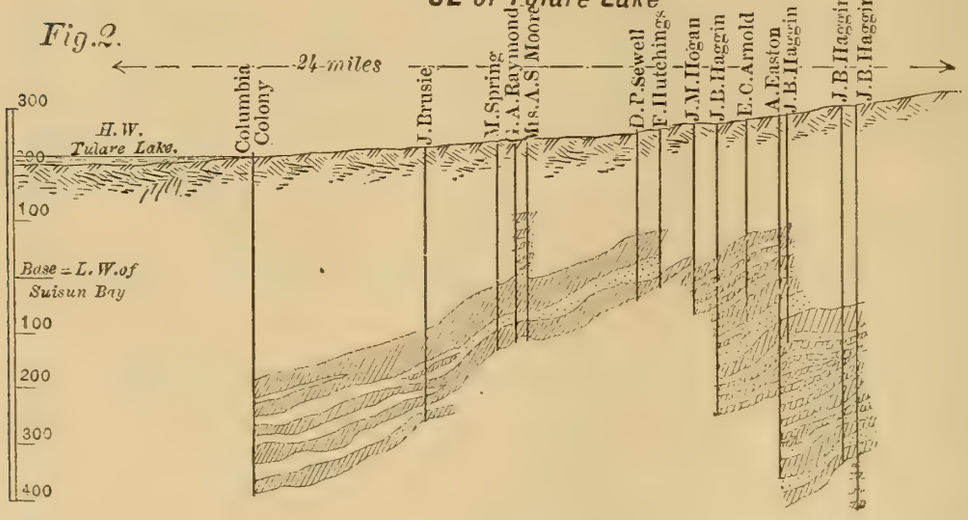
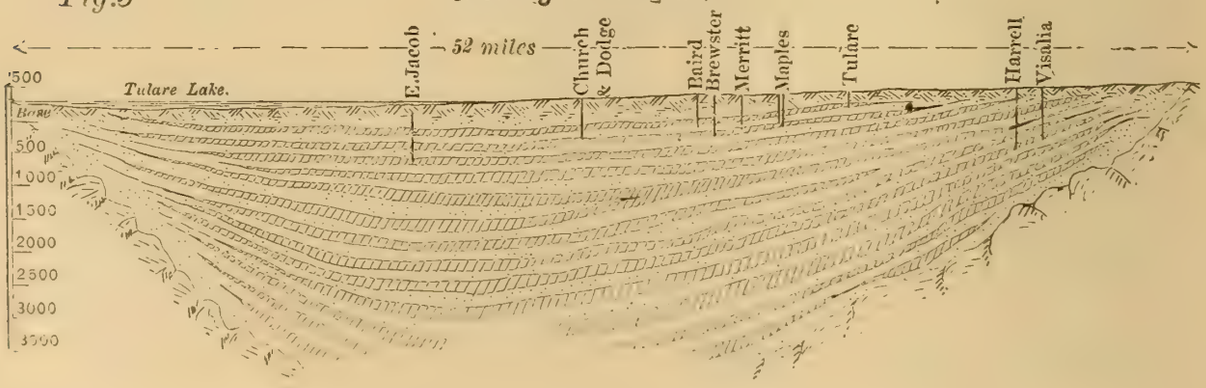


Fig.3

Ideal Cross Section of San Joaquin Valley through Tulare Lake, showing Stratification.



Base Low Tide of Pacific Ocean

trough of the valley directly west of Fresno, 170 feet at Merced, 20 feet at Stockton, 110 feet at the base of the hills east of Stockton.

The great eastern plain in the San Joaquin Valley has a surface slope of from five to ten feet per mile from the mountains toward the valley trough.

From the records of a great many deep borings it becomes apparent that to the full depth of the deepest boring in the San Joaquin Valley (about 3,000 feet at Stockton) pervious and practically impervious formations, of which clays and sands are typical, alternate in layers of varying thickness; that these layers have greatest thickness near the trough of the valley, decreasing toward the hills upon either side of the great valley; that their pitch from the hills toward the trough of the valley is greater than that of the surface, and increases with the depth, and that these layers lose their distinctive characteristics near the edges of the valley where, approaching the surface, they become merged in the surface formations.

The cobble, gravel and sand beds of recent formation at the outfall points of the many rivers and creeks upon the valley plains receive the sinking waters of these streams, and become the bountiful source whence the pervious strata of all depths draw their supply of water.

They may, when tapped from above, yield indifferent or excellent supplies of water according to the extent of each water-bearing stratum, the character of the material of which it is composed, the existence or non-existence of a natural point of outflow, and many other causes. The greater the depth from which the water rises the better is the prospect of obtaining an ample supply, because other conditions being the same, it is reasonable to presume that there is less likelihood that a natural outlet from a deep water-bearing formation should exist than in the case of others at a less depth.

Borings in the San Joaquin Valley, to the number of about 300, bear out these conclusions, and a careful study of the well-borer's records reveals the further fact that there are points where some cause has interfered with the continuity of the great clay deposits. These points lie near the present river channels, and it is very likely that a large flow of water down the present river canyons into the sea was accompanied by a sand flow deposited in long ridges out from the present base of the hills toward the west.

The Tule River outflow in Tulare Lake marks one of the points

where the deposit of clay has been interfered with. Kings River delta is another.

It must be apparent that when the source of supply can be so readily defined as in the case of the wells of the San Joaquin Valley that a conjecture is permissible as to the aggregate possible yield of all the wells in clearly defined districts. The writer's prediction in this respect in reference to the decrease of flow, or complete failure, of many of the wells in the San Joaquin Valley have fully borne out this view.

The combined flow of one hundred wells in Tulare County, examined by the writer in 1884, was 33 feet per second (20,384,000 gallons per 24 hours). Of these twenty had been examined two years before. Two of these re-examined wells had ceased to flow, both being located near the eastern or upper edge of the artesian well belt of the San Joaquin Valley. One of these had been sunk in 1878, and maintained a good flow until 1882, after which time, while the number of wells in the vicinity was being increased from 20 to 100, it gradually failed and ceased to flow entirely in the summer of 1884. The other was sunk in 1882, and its flow was then about 18,000 gallons per 24 hours.

The flow of twelve others of these twenty wells had decreased 56 per cent. in the two years, but the decrease had been so gradual that but few of the well owners would admit that a material change had occurred.

It cannot be hoped to establish the interdependence of wells in artesian belts of such great extent as those of San Joaquin Valley by means of experiments made in capping or uncapping wells. The great time required in producing an effect must needs make it impossible to establish with certainty a connection between cause and effect.

The effect is necessarily small, even when two wells are close together and are known to draw water from the same source. It is precisely the same as when two relatively small hydrants are connected by means of two separate pipes with a common large water main. The closing of one produces no perceptible effect on the other, because the hydrostatic pressure in the main is barely affected by opening or closing so small a vent. Yet, as every one knows, the many taps and hydrants distributed throughout a city provide escapeways for the entire water supply in the city main, and all combined are limited in their discharge to the amount which, from some source, is supplied to the water main.

Whenever the flow of an artesian well is checked, the hydrostatic pressure in the stratum from which it draws water is raised, and the longer the well remains closed the nearer will the same approach to that pressure which existed before the well was sunk. To this fact is due the phenomenon of the increased flow whenever a well is uncapped. In some cases such increased flow continues for hours, in others for days or weeks, and there is no doubt that after first being opened an artesian well in the central or lower part of San Joaquin Valley must flow for months before it settles to a constant or normal flow.

The long period required for such adjustment, which seems in conflict with hydrostatic laws governing the flow of water in closed conduits, is due to the influence of the friction to which water is subjected in its flow through pervious formations toward the point of discharge.

Having in the foregoing presented a condensed illustration of water movement in pervious strata sandwiched in between two impervious layers, the water bed and the water cap, the question: What becomes of the water which by infiltration through surface layers reaches the uppermost impervious layer by which its downward movement is interrupted? remains to be answered.

The intercepting layer may be but a few feet below the surface where a layer of genuine hardpan or bed rock lies under shallow soils and subsoils, or it may be at a great depth where porous sands and loams extend hundreds of feet beneath the surface. In either case the water intercepted by this impervious layer seeks its level. It flows, but its flow is retarded by the obstructions in its path.

The water in surface formations, above the uppermost impervious layer of clay or other material, is commonly designated surface or soil water, and is, as a rule, always found where rainfall is sufficient to wet the soil to a depth beyond the reach of capillary forces that bring the moisture to the surface where it is rapidly evaporated. Surface or soil water is augmented by seepage from natural or artificial water courses.

The rivers reaching the San Joaquin Valley from the slopes of the Sierra Nevada, are of two distinctive general types, those which, like the Calaveras and the Kern Rivers, debouche with their water surface at, or very nearly at, the general level of the valley lands, and those which hold their courses in secondary valleys, cut deep below the surface of the main valley, far out from the base of the mountains.

The Mokelumne, Tuolumne, Merced, San Joaquin and Kings Rivers belong to this second class.

To fully discuss the movement of underflow, and particularly of the increment due to infiltration from these rivers, and from the canals supplied by them, would carry this paper beyond intended limits, but some notes particularly of the region watered by Kings River will be given.

Kings River discharges into San Joaquin Valley the drainage from 1742 square miles of foothill and mountain lands. By far the greater part of its watershed lies in the high mountains of the Sierra Nevada, where nature stores the snows of winter to augment the flow of the river during the warm months of spring and summer. Kings River is generally at a low stage during the months of September to January inclusive, it is at a medium stage during the months of April to July inclusive.

The least average mean monthly discharge of the river for any month during the six years from Nov. 1st, 1878, to Nov. 1st, 1884, has been noted for November, it is 313 cubic feet per second. The least flow of the river noted for any single month of these six years was 220 cubic feet per second. The extreme low water flow of the river has probably never dropped below 200 cubic feet per second. At its medium stages this river carries 1,000 to 2,000 cubic feet per second, while during the high stages the monthly mean for the six years above named averaged from 4,000 to 8,200 cubic feet per second. The greatest momentary discharge of the river during this period occurred in June, 1884, at which time the discharge reached 30,000 cubic feet per second. (See P. D., State Eng. Dept., Cal., pp. 542 and 476.)

Kings River enters San Joaquin Valley at a point about 20 miles east of Fresno. It has a broad channel, between hills which rise very abruptly upon either side before it enters the Centerville bottoms. Through the bottom lands the river courses in a number of small channels, over and between cobble gravel and sand bars until at the "Narrows" it is again confined to one channel lying between bluffs about 60 feet high upon either side. Its length through Centerville Bottoms is about 14.5 miles, and its grade per mile 8.23 feet. At the upper end of Centerville bottoms the elevation of the plain is only about 10 feet above the river. At the lower end it is, as has just been stated, about 60 feet. Below these bottom lands the elevation of the river banks gradually decreases. About a mile below Kingsburgh the river water at medium and high stages divides, some

going westerly through Cole Slough to Fresno Swamp, thence to San Joaquin River, while the rest flows southwesterly into Tulare Lake.

At points where the plain is but little elevated above the surface of the river is the natural location for canal headworks. These are therefore found along Kings River in two groups. The upper one at the upper end of the Centerville Bottoms, the other below the crossing of the Central Pacific Railroad.

The lands of the plain generally slope away from the river, consequently there is little or no drainage from the plains into Kings River. Its only tributary from the hills, entering below the point where it reaches San Joaquin Valley, is Wahtoke Creek, which discharges into Kings River from the east at the Narrows.

The canals which supply Fresno and its surroundings with water are the Kings River and Fresno canal, the Fresno canal, the Fowler-Switch canal, and the Centerville and Kingsburg canal. These all take water from the north side of Kings River, about 18 to 20 miles east of Fresno.

The natural water courses of the Fresno plains are small creeks of torrential flow in the winter and no flow in the summer, whose waters are lost in sinks. These have in large part been utilized as the waterways for the canals, and the canals thus become the recipients of the drainage water from the plains and foothills.

The general slope of the valley lands near Fresno is from northeast toward the southwest at the average rate of about six feet per mile.

Near Centerville the soil of the plains near the bluff is a red sandy loam resting on a yellow clay, which is usually at a depth of four to six feet below the surface. The soil is sufficiently heavy to bake somewhat on the surface in drying out after being wet. Hard pan, as the clay is called, is not continuous ; it disappears frequently at about one half mile from the edge of the bluff, where the surface soil becomes lighter, more sandy. At depths of ten feet or more beds of cobble and gravel are here found which, in close proximity to the low river bottoms, afford thorough underdrainage to these lands. The soil is very productive. Ground water is at twelve to fifteen feet below the surface.

Westward from Centerville toward Fresno the soil is a loamy sand. This generally rests on irregular patches of firm clay hardpan, sometimes impregnated with sand. Soil is one to three feet deep. These plains in their original condition were treeless.

At the sinks of the creeks, which are generally a few miles to the eastward of Fresno, soil is a heavy red loam, bakes on the surface after being wet, where a hard-pan substratum is encountered at all it is at 10 to 30 feet below the surface. Westward from this region the soil is a heavy loamy sand several feet deep, resting on a firm clay called hard pan. This soil toward the southwest merges into the sandy soils of the alkali belt which skirts the edge of Fresno Swamp, and this in turn is succeeded by the rich peaty alluvion of the swamp lands. To the south of Fresno the sandy soils of Fresno and Central California colonies change to the light so called ash of Washington colony. Here the hard-pan dips further below the surface, and there are points where it has disappeared altogether. In the southern and southeastern portion of this district sand predominates. The surface of the country is comparatively smooth though crossed occasionally by a low sand ridge. Firm hard pan partaking of the nature of cemented sand immediately below the surface soil is an exception, yet is found in various localities, most frequently where the surface presents the peculiar hogwallow appearance.

All the clays and hard-pans of the region north of Kings River lack continuity, they have been honeycombed by burrowing animals, and are impervious only in relatively small tracts. The pervious character of surface soil is therefore to be considered uninterrupted on the Fresno plains to an uncertain depth of fifty to several hundred feet.

There is probably no other irrigated region in California where the effect of irrigation on the elevation of the water table, or on the amount of soil water, is so plainly apparent as in the immediate vicinity of Fresno.

Here, notwithstanding the six feet per mile slope of the surface of the country, the subsoils have gradually but surely been saturated with water. When irrigation commenced, the loss of water from canals in transit to lands to be irrigated was very great, and after reaching its destination it was found that frequently enough water was put on to the surface of certain tracts of land to have covered them to an average depth of 15 to 20 feet in a season.

The amount evaporating from the surface could not have exceeded five or six feet in the same time, consequently a vast amount of the water diverted from the river for irrigation must have found its way into the subsoils, and was certain to influence the elevation of the ground water. When the first wells were dug at Centerville water was found at about 20 feet, it is now at 10 to 15

feet below the surface, and will probably not rise much higher on account of ample drainage of subsoils and the proximity of the low river bottoms.

Along Fancher Creek, where the creek is used as a canal, ground water was formerly at 50 to 75 feet below the surface. It is now at 12 to 20 feet along the upper portion of the creek, and still nearer the surface near the former sink of the creek.

In the Eisen vineyard, five miles east of Fresno, ground water is at four to six feet below the surface, and drain ditches have been constructed to prevent a further rise. Ground water is only four feet below the surface in many parts of Temperance Colony, Nevada Colony, Fresno and Central California Colonies. Throughout a considerable area near Fresno it nowhere exceeds 16 feet below the surface.

Cellars which were in use until 1884 in Fresno have been condemned, because the ground water made its appearance in them. Yet in Fresno, and many miles to the west and south, no water could be reached at a less depth than 60 feet before irrigation commenced.

Near Selma and Kingsburg ground water was formerly found at about 30 feet. It is now at about 15 feet. The so called "Sand Hollow," which is a depression 100 yards to one fourth of a mile wide, 12 miles long, and about 15 feet deep, having a southerly course, and crossing the Southern Pacific R. R. about midway between Selma and Kingsburg, was formerly as dry as the surrounding plain. About 1880 the soil in its bed was found to require less moisture to produce crops than the adjacent plain. In 1885 water appeared at the lowest points of the bed, and in June of that year had risen to the heads of ripening grain. Spots of black alkali now mar its bed and sides, which before were a light sand apparently free from any excess of alkaline salts.

Near Sanders, and at points eastward toward Kings River, ground water was at 50 to 60 feet before irrigation commenced. It is now at 20 to 30 feet. Here, as in the case of Centerville, proximity to the river, which lies 60 feet below the surface of the plain, may interfere with a much greater rise of the ground water plane.

In connection with this change in the elevation of the ground water plane it must be remembered that it necessarily extends far beyond the points now under cultivation, and that owing to the slope of its surface, ground water has a slow but certain motion westward through pervious subsoils, and will ultimately contribute more

or less toward the flow of Fresno Slough and San Joaquin River.

The rainfall in the Fresno district is greatest near the base of the foothills. It decreases from there toward the west. At Centerville the average fall of rain is about 16 inches, while at Fresno and Kingsburg it is 9 inches. The average fall at Firebaugh in the trough of the valley is about two thirds of that at Fresno. For the irrigated region near Fresno the mean annual fall of rain may therefore be noted at about 11 inches. When this amount of rain falls at the proper time it is sufficient to insure good crops of grain. Throughout a large part of the district this rainfall is relied upon to produce a crop, and irrigation of grain is as a rule resorted to only when a drouth threatens the destruction of a growing crop.

The branches of the canal which supply this region with water ramify through a region covering about 300,000 acres, with plenty of room for extension to the north and west.

Two of the canals irrigating lands near Fresno have a perennial flow, the others divert water only during medium and high stages of the river, generally from January to August inclusive.

The aggregate capacity of the four canals already enumerated is about 1,550 feet per second. None of them flow for long periods at their maximum capacity. The demand for water is fortunately greatest at the time when the flow of the river is greatest during spring and the early part of summer.

Each of these canals was constructed for the purpose of supplying water to some particular locality. Thus Fresno canal to irrigate lands in the immediate vicinity of Fresno ; the Kings River and Fresno canal to irrigate a strip of land just north of Fresno canal ; Centerville and Kingsburg canal to irrigate lands near Selma, and Kingsburg and Fowler Switch canal to supply water to the vicinity of Fowler and lands westward from that point. By reason of such requirement in each case, each canal received an alignment as direct as possible from the proposed source of water to the point of delivery. The main canals were therefore constructed without any attempt to hold them to any uniform grade. They have alignments in the direction of the greatest fall of the country, and generally when their grade is excessive checkwiers are used to prevent erosion. The flow and elevation of water in the Kings River and Fresno canal, and in the Centerville and Kingsburg canal, is thus regulated. The control of flow and elevation of water in the case of Fresno canal and the Fowler Switch canal is only partial.

Fresno canal, throughout a large portion of its course, occupies

the deep channel of Fancher Creek. Its water flows 8 to 15 feet below the surface of the ground. Very few structures are in use to raise it to the surface, and but little of its water is diverted from this part of its course. The first important diversion from the Fancher Creek portion of the canal is at the Limbaugh dam where the Mill Branch is diverted from the main canal; the second is at the Hobler dam where water is diverted for the Eisen ditch and for the Briggs branch. Below this point the channel of the creek has less depth, and soon reaches its sink whence the canal water flows in artificial channels whose grade is regulated by the same structures which enable diversion of water into the distributaries.

Fowler Switch canal was constructed on a very irregular grade line. Its grade, when possible, was placed at 1.92 feet per mile, which was established as a minimum gradient. At some points, however, the grade was no less than 12 feet per mile for short distances. The dimensions of the canal were calculated on a basis of a fall of 1.92 feet per mile, consequently its dimensions where this grade was exceeded are excessive.

The canal was constructed without structures for the regulation of its flow, or to facilitate diversion. Rapid erosion at once commenced where the canal bed was not in very firm material, and after a short experience a limited number of checkwiers were put into it at the points where most required.

The structures in this and in the other canals of the district are very light but generally well adapted for the purpose which they are to serve. In view of the fact that the irrigation of this district has in the past caused a rise of the ground water plane, and that it will continue to influence its elevation, the question whether, in the end, water is lost by the apparent duplication of canals remains an open one. Certain it is that were all water drawn from the river in one main canal it would still be necessary for branch canals to reticulate through every portion of the irrigated region, the ground water would be expected to rise equally as rapidly as at present, and the only saving of water would result from the exposure of a slightly decreased surface area of flowing water to evaporation, and from a possible reduction of the flow of water from the main canal through subsoils back into Centerville Bottoms. This last saving may be admitted as possible, though it is equally probable that the increased depth which one main canal would have would augment the loss.

To illustrate how insignificant the loss of water from a canal by reason of evaporation is, the average surface width of Fresno canal

throughout its 24.5 miles of length (main canal only) may be noted at 60 feet, and the rate of evaporation may be taken at the maximum average rate per month recorded for any month in the records of the experiments at Kingsburg.* The greatest total evaporation in any month of the four years, November 1st, 1881, to November 1st, 1885, occurred in August, 1883. It was equivalent to a layer of water .945 feet in thickness. At this rate per month the loss by evaporation from the surface of Fresno canal would have been equivalent to a continuous flow of 2.8 cubic feet per second, an amount very small when compared with the amount sinking into the subsoil, or with that remaining available for distribution.

To determine the amount of water which sinks into the subsoil from the canals in the district under discussion, experiments were made in 1882 along Kings River and Fresno, Fresno and Centerville, and Kingsburg canals.

The first of these canals cuts immediately into the high land north of the Centerville Bottoms. For a long distance it is nearly parallel, and sometimes very close to the Fresno canal. Its water surface is at a higher elevation than that of Fresno canal. At many points the canal carries its water above the surface of the adjacent plain. Ponds and swamps are maintained with the water which the canal loses by percolation.

The canal, throughout the last few miles of its first twelve, lies in a good channel with hard-pan bed. Throughout this upper portion the canal in 1882 lost water at the rate of 3.77 cubic feet per second per mile. At that time the canal below Red Bank Creek, about twelve miles from the canal head, was poorly maintained. Water was allowed to spread out in ponds, and a former channel lying parallel to the present canal, and generally very close to it, frequently carried part of the canal waters.

The water surface of the canal was held at an elevation slightly greater than that of the land upon each side. No lands in this section of the canal were irrigated close to the main canal. Ground water was at about 20 feet or more. An indurated clay hard pan lies below the surface soil along this portion of the canal. Here throughout 4.76 miles in length of the canal its average loss by percolation was 3.45 cubic feet per second per mile, a trifle less than in the 12 miles above.

At the point here reached copious irrigation of lands close by the canal, particularly on the south side, had been practiced for

* State Engineer Dept., Physical Data, p. 379.

several years preceding the experiments. Soil is a light sandy loam with ground water at from 7 to 14 feet below the surface. The water surface of the canal was carried at about the elevation of the ground. Land here is very smooth, no high levees are necessary to hold water in its channel. The canal is of uniform dimensions and character, and is better maintained than at points above. These circumstances all combine to reduce the loss by percolation, which here, for 3.75 miles, averages 1.25 cubic feet per second.

Evaporation at the maximum rate above noted would have caused a total loss from the 20 miles of main canal under consideration of a little more than one cubic foot per second, equivalent to a loss of 0.04 cubic feet per second per mile in length of the canal.

The water of Fresno canal flows in natural channels throughout nearly all of the first 19 miles of its course. It lies in the Centerville Bottoms for a mile at its head. Its waters, after passing through Long Cut, are carried into sloughs and depressions, frequently with a levee only along its south bank. Willows, weeds and grasses grow in the water and on the banks of the canal in this locality. In Mud Creek and Faucher Creek the canal water flows in the bottom of a narrow deep channel.

At the time of making the experiments, in June, 1882, there were 95.51 cubic feet of water per second lost from the canal in the first 11¼ miles of its course below the point where it leaves the river bottoms. The loss of water was at the rate of 9.1 cubic feet per second per mile. This great loss must be ascribed principally to the absorbing power of the dry subsoils. There can be no doubt that as ground water rises throughout this district the amount which the subsoils absorb will decrease, and it may be even that the time will come when the flow of the main canal will be augmented at points where its water surface lies far below the surface of the ground.

The ground water plane was already quite close to the ground near Fresno canal in its next section, from the Limbaugh dam (the head of Fresno Mill ditch) to the head of Washington Colony branch, a distance of 7.00 miles, throughout which the total loss by percolation was only 5.20 cubic feet per second, or 0.74 cubic feet per second per mile. Here the depth to ground water ranged only from 4 to 10 feet, and the surface soil and subsoils were kept saturated by water diverted for irrigation. The canal lies in a natural channel, its water surface is generally two or four feet below the surface of the ground.

From the head of Washington Colony branch the main canal

flows for four miles in an artificial channel of uniform dimensions to the railroad. Water is carried about at the elevation of the surface of the ground. The lands adjacent to this part of Fresno canal were practically unirrigated in 1882; ground water was not as near the surface as in the preceding canal division. The total loss in this division of the main canal was found to be 3.81 cubic feet per second, or 0.95 cubic feet per second per mile.

Centerville and Kingsburg canal, for about eight miles after reaching the top of the bluff, has a course parallel to its edge, and never distant from it over one half mile. For several miles, commencing about one mile below Centerville, the canal is only from 200 to 500 feet distant from the edge of the bluff, which is there 20 to 30 feet high. This location in a porous soil and subsoil causes great loss of water by percolation. Nearly 86 cubic feet per second were lost by the canal in less than six miles, and in its seventh mile the canal lost no less than 52.35 cubic feet per second.

(This last result is based on measurements of the flow of water over two wiers, one mile apart, apparently in good condition.)

The average loss per mile from the canal in the 5.50 miles of the upper division examined was 15.63 cubic feet per second.

Other examples of the loss of water from canals and ditches by percolation into the subsoil are the following:

On June 21st, 1882, E. F. Davis was using water for the irrigation of his vineyard in Scandinavian Colony. The water was diverted from the main supply canal into a small ditch about two feet wide. It was conducted past alfalfa fields and vineyard lands a distance of one half mile to the point where it was being used for irrigation. The soil crossed by the ditch is a sandy loam, ground water was at eight feet below the surface. Water was measured at the point of diversion and at the point of delivery in exactly the same way (over small overfall wiers). The amount diverted was 1.70 cubic feet per second, and the loss in transit 0.79 cubic feet per second.

On June 14th, 1882, the orchard on the Gould ranch, north of Fresno, was being irrigated. The water used for this purpose was flowing in a ditch having an average width of three feet. One mile above the point where the water was being used the discharge of the ditch was 2.41 cubic feet per second. The loss by percolation before reaching the point of delivery was 1.42 cubic feet per second. Shade trees were growing along portions of the ditch and its banks were overgrown with grass. The ditch had been in use several

years. The soil through which it flows is a sandy loam five to eight feet deep.

On June 20, 1882, the west branch of the Eggers ditch was flowing 3.52 cubic feet of water per second. It lost 0.76 cubic feet per second in the course of one mile. The ditch had been in constant use for a long time. On the same day the east branch of this ditch lost 0.47 cubic feet per second in the same distance. The flow at its head had been 2.97 cubic feet per second. Both of these branches are about four feet wide. Ground water was 7 to 9 feet below the surface. Soil is a sandy loam, probably about eight feet deep.

On June 26th, 1882, a ditch which leaves Fresno canal in Sec. 5, T. 13 S., R. 21 E., was carrying 5.60 cubic feet of water per second near its head. One mile below the canal was receiving 0.03 cubic feet per second. At the S. W. corner of the S. E. quarter of Sec. 6 it was receiving 0.49, and one quarter mile further west 0.15 cubic feet per second. In the middle of Sec. 11, T. 14 S., R. 20 E., the flow of the canal was only 1.89 cubic feet per second. Its flow had decreased, by reason of the percolation into subsoils, 4.38 feet per second. This ditch has an average width of about eight feet. It carried its water at or a trifle above the level of the ground's surface.

The results of the measurements made by the writer in 1882, then acting in the capacity of Assistant State Engineer, are presented in the following tables, on the next and succeding pages, taken from unpublished records of the State Engineer Department, now abolished.

Whenever the measurements were made at weirs where leakage was suspected, or at points where conditions for gauging were not satisfactory, results have been noted as approximate.

LOSS OF WATER FROM THE KINGS RIVER AND FRESNO CANAL.

(Measurements by C. E. Grunsky, Assistant State Engineer.)

Name of Canal or Ditch and Locality.	Distance Below Head of Canal. Miles.	Discharge. (cu. ft. per sec.)		Loss between Stations. (cu. ft. per sec.)	
		Main Canal.	Diverted	Total.	Per Mile.
K. R. & F. C., one half mile below head.	0.50	133.83	.....		
Burns Ditch	1.00	.....	0.25		
Hansen Ditch.....	4.00	.....	3.23		
Fansher Creek (wastage).....	8.00	.....	0.30		
Ditch on South Side.....	8.00	.....	4.05	43.36	3.77
Ditch on South Side	9.00	.....	0.05		
K. R. & F. C. at Hawkins Weir.....	9.00	*78.18	.....		
Wastage...	.....	.....	0.15		
Ditch on South Side.....	11.50	.....	2.04		
K. R. & F. C. in Red Bank Creek Flume.	12.00	80.40	.....		
Dog Creek (wastage).....	13.25	.....	0.15		
Ditch on North Side.....	16.00	.....	3.36	16.50	3.48
Eggers Ditch...	16.75	.....	4.67		
K. R. & F. C. at Eggers Weir.....	16.75	55.72	.....		
K. R. & F. C. West Line of Section 17..	17.75	*49.56	.....		
Ditch South Side.....	17.80	.....	3.08		
Scand. Col. Ditch.....	18.25	.....	3.86		
K. R. & F. C. at Upper Scand. Col. Weir	18.25	*36.74	.....		
Scand. Col. Ditch.....	18.35	.....	1.46		
Scand. Col. Ditch.....	18.50	.....	2.42		
Scand. Col. Ditch.....	18.60	.....	1.00		
Scand. Col. Ditch.....	18.70	.....	2.39	4.44	1.25
Scand. Col. Ditch.....	18.80	.....	14.50		
K. R. & F. C. Lower Scand. Col. Weir..	19.00	*25.51	.....		
Big Creek (wastage).....	19.25	.....	1.50		
Wastage.....	.....	.....	0.20		
Ditch on North Side.....	19.75	.....	0.43		
Cooper & Helm Ditch.....	20.25	.....	8.71		
K. R. & F. C. at Cooper Weir.....	20.30	11.73	.....		

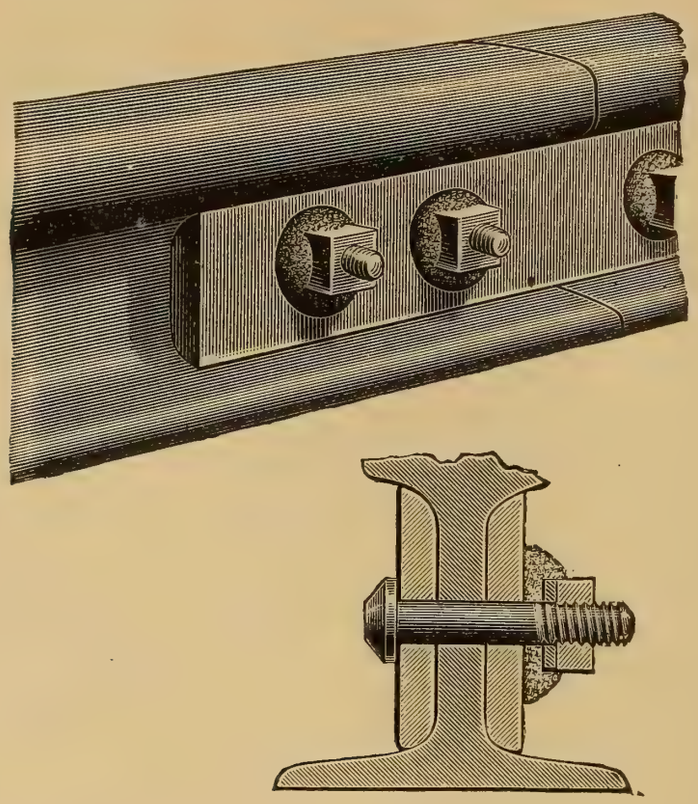
*Approximate.

LOSS OF WATER FROM THE FRESNO CANAL.

Name of Canal or Ditch, and Locality.	Distance Below Head of Canal. Miles.	Discharge. (cu. ft. per sec.)		Loss between Stations. (cu. ft. per sec.)	
		Main Canal.	Diverted	Total.	Per Mile.
Fresno Canal at Road Bridge	1.25	381.00	.....		
Centerville Branch	1.75	.....	17.80		
Lone Tree Branch	3.25	.....	69.39	95.51	8.49
Ditch on South Side	5.00	.....	0.50		
Limbaugh Dam Ditch	12.50	.....	58.72		
Fresno Canal at Limbaugh Dam	12.50	139.08	.....		
Briggs Canal	14.00	.....	0.30		
Eisen Canal	14.00	.....	14.09		
Fresno Canal at Hobler Dam	14.00	107.88	.....		
Easterly Ditch	17.25	.....	5.60	5.20	0.74
Malters Ditch (North)	19.00	.....	6.30		
Malters Ditch (Central)	19.00	.....	1.69		
Washington Col. Branch	19.50	.....	45.50		
Fresno Canal at Head of Wash. Col. Branch	19.50	60.40	.....		
Fresno Col. Canal	23.50	.....	14.15		
North Central Col. Canal	23.50	.....	13 88	3.81	0.95
Main Central Col. Canal	23.50	28.16	.....		

LOSS OF WATER FROM THE CENTERVILLE AND KINGSBURG CANAL.

C. & K. Canal, ½ Mile Below Head	0.50	346.00	.....		
Ditch on West Side	5.50	.....	5.06	85.94	15 63
do	5.75	.....	4.00		
C. & K. Canal at Weir, in Sec. 23	6.00	251.00	.....		
Garfield Canal	7.00	.....	26.65	52.35	52.35
C. & K. Canal at Weir, in Sec. 26	7.00	172.00	.....		



SWEETLAND'S NUT LOCK.

This novel expedient for securing nuts on railway bars and elsewhere, is the invention of Dr. W. P. Sweetland, of this City, and from some specimens of fastenings examined, seems to answer the intended purpose in an admirable manner.

There has been a wonderful number of mechanical detents or fastenings of one kind or another for this purpose, but none that have so far as we know commanded favor enough to secure general adoption. Such devices have either depended upon elasticity to maintain tension on the bolts, or to prevent the nuts from turning by some mechanical obstruction. In the present case both of these functions are combined in the following manner:

A fibrous washer, preferably of felt, is saturated with some plastic substance, such as asphaltum, or any drying pitch that will harden or become tough when exposed. This washer, after saturation, is placed on the bolt and on top of this a common thin washer equal to the shortest diameter of the nuts. When the nuts are screwed down the fibrous washer affords an elastic bearing and while the plastic material causes the felt to "flow" around the corners of the nut, as shown in the drawing, where it dries or hardens, forming a matrix in which the nut can not turn unless by the force of key or

wrench. If the nuts are to be removed the fibrous material beyond the inner face of the nuts is shaved off when the nut is forced back; no more time being required than in the case of unlocked nuts. It will also be understood that the screw threads are protected from corrosion.

The appearance of the joint when fastened in this way is quite neat, and as the extra labor involved is no more than putting on the washers, there will not be the objection of special nuts, special tools or extra labor, things that are hard to provide in the routine of trackmen's work. We are much interested in seeing an experiment made with these lock nuts on some "permanent way" and expect a good report of them.

STAINED GLASS IN AMERICA.

A recent contribution in the *Forum*, from Louis C. Tiffany, of New York, under the somewhat bombastic title of "American Art Supreme in Colored Glass," will be a surprise to at least nine tenths of the people in this country. It is commonly supposed that colored glass was a part and portion of old country cathedrals, an art like some others, born of religious zeal and resources, but Mr. Tiffany claims that this country is preëminent in the art, or "supreme," as he chooses to call it. He shows that this result is mainly because there is no enthrallment of tradition, and people set out in their own way to produce beautiful and pleasing designs.

Mr. Tiffany begins his article in the following words:

"Walter Savage Landor, it is said, would not visit America because there was no stained glass to be seen here. Since the eccentric Englishman made this remark great changes have taken place, and today this country unquestionably leads the world in the production of colored glass windows of artistic value and decorative importance. The truth of this statement is not perhaps fully recognized even by our own people, for you will look in vain in the great 'White City,' on the shores of Lake Michigan, for a department in the Exposition devoted exclusively to exhibiting the results of the development in this particular art."

It is noteworthy, and to be regretted, that there are no exhibits of this kind of work at Chicago, besides is remarkable, because in arts of the kind not essentially utilitarian we are charged with a want of taste in such productions. There are other such omissions at the great fair, and the circumstance recalls a remark of the ami-

able Mr. Pickwick, that "people usually pride themselves most on what they least understand."

Stained or colored glass is becoming more common as everyone must observe, and we predict that unless there is a high duty placed upon it that American skill will manifest itself in producing such work at a greatly reduced cost, and, if let alone by our paternal legislators, will, no doubt, become an article entering into export trade.

We are unable to transcribe enough from Mr. Tiffany's article to explain all the points wherein American artists have added to the art of preparing stained glass, but will mention a few.

In producing drapery for figure work the old expedients were expensive and imperfect, consisting of compounding a large number of pieces side by side. In this country the glass, when in a plastic state, is forced into folds and wrinkles, producing a realistic effect at little expense. Paint is almost unused in this country. Effects are produced by coloring and arrangement, and thus the work is more durable and substantial.

The processes of the work are thus described by the writer:

"The form of the window having been chosen, the artist prepares his color sketch in order to get his composition for the cartoon and the scheme of color for the glass. From this sketch a full-sized cartoon is made, the figures in which should be studied carefully from life. When the cartoon is completed two transfers are made on paper, just as an embroidress makes a transfer from her pattern to the linen. One of these transfers is kept as a guide for the artist who leads the glass together; the other is divided into patterns, the divisions following the places of the lead lines as the cartoon indicates. These divided pieces are then arranged upon a glass easel, which is placed against the light. The artist, having previosuly selected the glass required or caused it to be made under his supervision, chooses a piece of glass for, we will say, the sleeve of a garment, first removing from the easel the paper pattern so that he may pass the glass between himself and the light over the opening left by the removal of the paper. Having found the proper piece the glazier marks that portion of the sheet that is to be cut, places the paper pattern upon it, following the edges with a diamond, and thereby cutting the glass to the form desired. When this piece of glass corresponds exactly with the template, it is placed upon the glass easel and held in position with wax, taking the place of the paper pattern. This is continued until the entire window is cut and placed upon the easel. From time to time the artist may see reason to modify or change from the original color scheme, or even from the drawing in the cartoon, as he may find pieces of glass which give better effects in his judgement than that indicated in either the sketch or the cartoon."

NAVAL COMMANDERS AS NAVIGATORS.

Before naval officers of the line assume the management of the motive power and machinery of war vessels, it will be as well to consider how far they have gone in navigation, including in that term the "handling" of ships.

In the British navy the late and terrible end of the *Victoria* brings up this problem. This great vessel was, even in her short career, once stranded, and saved by a lucky wind that enabled her being pulled off. The *Captain* was lost for want of stability, but stability should not be a mystery, and is chargeable to errors of computation that have no parallel in determining the motive elements of war vessels. The *Sultan*, another powerful war vessel, was "hung up" on the rocks about three years ago, her repairing or rebuilding is not yet completed. The *Howe*, a third great ship, was also driven on the rocks and "blasted off;" she too must be rebottomed.

The *Warspite*, flagship of the British squadron on this Coast, got on the rocks near Victoria, B. C., last year, and was much damaged. The *Undaunted*, a first-class cruiser, has been stranded on the rocks, and both the *Naiad* and *Apollo*, new cruisers, were run ashore when maneuvering.

In the last year three ironclad ships, one armored cruiser, and three unarmored cruisers have been unfitted for duty by accidents of navigation. In other countries the policy of the service is to conceal such mishaps, and there has, no doubt, been a proportionate amount of blundering all around. There should, indeed, be more if taken in proportion to the number of vessels, because no other nation has such resources for training commanders, or half as many to train.

Contrasted by mileage with merchant steamers comparison is out of the case. No company could maintain a line of steamers if there were one half the accidents that occur in the naval service.

It may be said war vessels are heavy, unwieldy and have to perform evolutions not required in the case of merchant steamers, which is true, but when the causes of accidents are looked into, a large share of them come from a want of navigating skill and knowledge, as in the case of the *Victoria* and the *Sultan*. The fact is there is too much college, and too little sea, in the modern methods of educating naval officers.

FINANCIAL WHIMS.

The following extract is reprinted from an article in the *Nation*, because it contains a number of new "ideas" on the silver problem that will be of interest at this time.

"The monetary system of the United States adopted in 1878 has worn itself out. This system went upon the theory that a cheap dollar is a good thing for the poor. Silver was the cheapest material that could be found of which to make dollars, after paper had been rejected, as it was in the elections which followed President Grant's veto of the Inflation Bill. So silver was taken up as the next worse thing, and has been coddled and made much of during the fifteen subsequent years. But it is now plain that silver has done no good to anybody. Most people are beginning to suspect that what the poor man really needs is the best kind of money that the world affords, and not the worst kind. What would be the situation of the poor man, regarded as a savings depositor, if all his money should be repayable in funds worth only fifty-five cents to the dollar? What would be his situation as a laborer for hire if his wages should be payable at the same rate? "He would strike for higher wages," would he? Yes, he would be compelled to do that, unless he was willing to lose half of the pay he had received before. Then the question whether the strike would succeed would be open to dispute and would not be settled under three years at least. The employer would say that he could not raise the price of his goods so as to recoup himself, because his customers would not pay the advance; and so forth and so on. If the poor man were once brought into close contact and acquaintance with the 55-cent dollar that Congressman Bland and Congressman Bryan want to force upon him, he would make it very interesting for them. They would be "held up" at every turn of the road. It is really a mercy to them to prevent them from doing what they want to do and then falling into the hands of their victims.

As the 55-cent dollar recedes from view a lot of other oddities come into the field of vision. Our table is piled with them. One of them is the "goloid dollar." This is an old acquaintance composed of say 55 cents worth of silver and 45 cents worth of gold melted together. Another is a new system of bank note issues based upon silver and gold in equal parts. This might be called the goloid bank note. Still another is a proposed issue of interconvertible bonds which can be turned into currency whenever money is worth more than three per cent. interest and the currency converted back into bonds whenever it is worth less than three per cent. This is likewise a venerable Joe Miller of finance. It had great popularity before the silver craze set in. The latter "knocked it out," and now it comes up smiling after a retirement of fifteen or eighteen

years. All these snuffy old things proceed upon the theory that if the Government will only devise some kind of cheap dollar the people will be able to get it easily, but that each dollar will still buy 100 cents worth of all the commodities needed to keep house with, just the same as a gold dollar. This expectation is as philosophical as it would be to suppose that a dozen gamblers shut up in a close room could increase their total winnings by using pasteboard chips instead of wooden ones.

We do not mean to deal harshly with people who, with honest purpose, bring forward what they consider to be remedies for the troubles into which silver legislation has brought us. Most of them have had silver dinned in their ears until they really think that, in order to have any money at all it is necessary to dilute it and make it half good and half bad. A writer in the *Tribune* asks that paper whether it is not true that the $322,000,000 of silver certificates outstanding represent that number of coined silver dollars, being the same, to all intents and proposes, as though the coins were in circulation. The *Tribune* replies that these certificates derive their gold value from the credit of the Government and its promise to keep the two metals at par with each other; hence that the existence of a corresponding lot of silver coins in the Government vaults is of no consequence whatever, and that these silver coins might as well be sunk in the Atlantic Ocean. Very true and very well put, but the *Tribune* goes on to say that the only real silver dollars that circulate are the $57,000,000 that are moving about in the pockets of the people. Now this $57,000,000 is just as much "fiat" money as any part of the $322,000,000 which takes the form of silver certificates. If these dollars were circulating at their bullion value, every one of them would drop to 55 cents and probably lower, since the commercial world would expect them to come on the market as bullion before very long. This the *Tribune* has not quite made clear to its correspondent.

One of the oddities of the situation is that many people who hear and read about the "fifty-cent dollar," understanding that it means the silver dollar, refuse to accept these dollars at all. They will accept two half-dollars, or a silver certificate, without question, but a "cart-wheel dollar" or a "buzzard dollar" they will have nothing to do with. Of course these people are mistaken, but can we expect that all the people will understand these intricate matters after Congress has muddled them over and over again for thirty years so that only a minority of the people know what it is to have a sound monetary system? These people who refuse the cart-wheel dollar in trade are not more obfuscated than the silver editors who insist that they can be compelled to take them. "Are they not legal tender?" ask these sapient writers. "Why then should not everybody be compelled to take them?" This phraseology betrays ignorance of the fact that legal tender laws operate only on past contracts. They have nothing to do with the present and the future.

Therefore if a grocer declines to take silver dollars for tea and

candles sold over the counter, or if the customer refuse to take them in the way of change, the fact that they are legal tender is of no account.

For the first time in a whole generation, there appears to be the sign of a dawning of common sense on the subject of money and finance."

AIR TRANSMISSION.

Mr. John T. Nicholson, B. S., a member of the Canadian Society of Civil Engineers, has prepared and read before that Society a valuable paper on the "Transmission and Distribution of Power by Air," that comprehends the latest knowledge and practice in this method. The quantities dealt with in the paper are technical and in some respects rather complex, but are conservative. The whole problem of air transmission is narrowed down to ultimate efficiency, so the theories of air compression, and even the mechanism, is losing interest, because of the exhaustive treatment the subject has received during five years past.

Mr. Nicholson's conclusions are as follows:

"In concluding this part of the paper it will be well to recapitulate in brief the several efficiencies of the different parts and the combined efficiency of the whole system for one or two of the cases most likely to occur.

The mechanical efficiency of the compressing machine may be safely taken to be 0.86; the Paris installation compressors gave this result, and with the new 2000 horse compressors Riedler has obtained 0.9. A turbine will give from 0.75 to 0.80 for the same ratio.

The thermodynamic efficiency of the compressors is for a single-stage compressor with spray injection, 0.85 and for a two-stage compressor 0.92.

The loss in the mains due to leakage and fall of pressure for a five-mile transmission, may be put at 3.8 per cent., so that the efficiency of the mains is 0.962.

The thermodynamic efficiency of a simple adiabatic motor without preheater is 0.77; of a two-stage adiabatic motor, 0.9; of a simple preheated motor, 0.8 to 0.9; and of a two-stage preheated motor, 1.1 to 1.3."

Reverting to the efficiencies given, and taking them from power developed with a compressor at .85, conduit mains 0.9, and pneumatic motor at 0.8, which is below the estimates assumed in the paper, $0.85 \times 0.9 \times 0.8 = 61.2$ per cent. efficiency, which is actually attained in Paris, and can be attained anywhere with machinery of the best class.

Mr. Nicholson's conclusions are that after allowing for all kinds of charges, a central station can furnish power by pneumatic apparatus for $24 a year for each horse power, and realize a profit of 10 per cent. If so the business is a good one to engage in. The small users in this City would gladly purchase power at three times this rate and would save thereby.

On this Coast where two-stage compression originated, so far as we know, our ideas of air transmission are based mainly upon rock-drilling machines, and other wasteful apparatus. Nothing has been done in reheating at the point of consumption, this is essential to attain 0.9 efficiency, or near it; 77 per cent. is the ultimate computed efficiency of motors operating adiabatically.

THE TECHNICAL SOCIETY OF THE PACIFIC COAST.

This Association met on the 4th of August, Past President Marsden Manson presiding.

The following new members were elected :

Julius H. Striedinger, Civil Engineer.....San Francisco, Cal.

A. Patton, County Surveyor.....Tulare County, Cal.

Two names were proposed for membership.

The committee on the Midwinter International Exposition reported that Mr. Alexander Badlam, the Secretary, had been called upon, and that officially the offer to coöperate with the General Committee had been accepted, and that the Committee from the Technical Society would be notified in due time when their services would be desirable. For the present nothing of a technical nature is required in the organization of the Exposition.

A letter was read from J. A. Woodson, for the Committee of Promotion, asking that two delegates from the Technical Society be sent to attend a meeting of the State Road Convention, to be held at Sacramento, September 7th.

The Chairman stated that the President had appointed Messrs. Julius H. Striedinger and O. H. Buckman to act in that capacity.

The following report of the committee having under consideration the merging of the California Electrical Society into the Technical Society was read :

San Francisco, Cal., July 7, 1893.

To the Technical Society of the Pacific Coast:

Your committee, appointed to confer with a committee from the California Electrical Society, for the purpose of considering upon what basis a union of the two societies might be effected, hereby respectfully reports:

That such union might be brought about by admitting the members of the California Electrical Society in a body, respectively as full, associate and junior members of the Technical Society, upon a classification made by themselves on the basis of the qualifications as laid down in the constitution of the Technical Society, the classification list to be submitted to and approved by the Board of Directors of the Technical Society.

That, in such admission of the members of the California Electrical Society, the usual form of election be waived.

That no initiation fee be exacted.

In order to effect the absorption of the California Electrical Society upon the above basis, your committee suggests that the Board of Directors be authorized to examine and, if satisfactory, approve the classification list of the members of the California Electrical Society as by it submitted, and that on their recommendation the union be effected by unanimous consent at a regular meeting of the Technical Society.

G. W. Dickie,
John Richards,
D. C. Henny.

Upon motion the matter was referred to the Board of Directors, with full power to take action on the basis as outlined in the report.

A communication was read from Past President Mr. John Richards, proposing for honorary membership in the Technical Society Chief Naval Constructor Theodore D. Wilson, now Commodore, U. S. Navy. The resolution was accepted, and the communication referred to the Executive Committee for action and approval.

To draw suitable resolutions of respect in memory of the late P. J. Flynn, the President had appointed the following committee of Los Angeles members: Fred Eaton, Chairman; Burr Bassell and Valentine J. Rowan. A communication was read from Mr. Bassell, wherein the Committee asks for an extension of time until the September meeting. The request was granted.

Mr. W. A. Doble read a paper entitled: "Use of Coal Oil in Steam Boilers," which is printed elsewhere in this issue.

Mr. Marsden Manson read a paper written by President Grunsky, entitled: "Notes on Artesian Water, and the Effect of Irrigation on Subsurface Water in the San Joaquin Valley," a portion of which we republish in the present issue.

ELECTRICITY.

NOTES.

The latest thing in electric matters is the "electrophone," an exaggerated telephone adapted to transmit music and speech from concerts, theaters, or other places of amusement, to be "resold" in an abridged form in distant places, or for pleasure at home in private dwellings. The method will readily suggest itself, but the main point is in the scheme as it is carried out in London and Paris, already on an extended scale. In Paris there are fifteen hundred subscribers for the company's transmitted amusement. The system will, no doubt, be extended to the House of Commons, in London, if the privilege can be obtained, and an extra price charged when there is a "scrimmage" there, such as occurred in July. The main use will no doubt be in transmitting church service and sermons thus avoiding the necessity of early rising and the trouble of going to church, also in the avoidance of fees, or contributions, as they are called.

It is announced that Messrs. Shippey Bros., of London, England, have succeeded in producing a new kind of carbon filament for incandescent lamps that has the property of being cut, rolled and shaped. The filaments stand a voltage of 200. The material is called fiberite. On the expiration of the Edison-Swan patents in November next, there may be expected a revolution in lamp manufacture in England, where the monopoly has been complete. There is nothing improbable in the discovery of a new material, or rather a new source for material for lamp filaments. It is true that Mr. Edison, who is most likely of all men to discover such a thing, has rested his efforts with vegetable fiber, and no one to the present time has gone farther, but the field is wide, and judging by other things electrical, the search is by no means ended.

The General Electric Company continue to bring suits against those manufacturing the Edison filament lamps, and so far as we have noticed with uniform success in securing injunctions in the Circuit Courts. Mr. Edison is said to have remarked after the first hearing and decision on this important issue that "he always sus-

pected that he was the inventor of filament incandescent lamps, and now he felt quite sure of it." By this time his opinion must be pretty well confirmed on that point. There is an alarming inference in the disregard of this novel invention and the patents thereon, a disregard that has not the excuse of oppressive monopoly, because, so far as we know, the price of the lamps has been reduced as fast as the improvement in manufacture permitted. It is an invention surrounded by a good deal that may be called romantic, if that term will apply to such things, and indicates the difficulty of maintaining a patent on any invention of wide use.

ACCUMULATOR CARS IN SAN FRANCISCO.

If the experiments now being made with electric storage batteries for propelling street cars in this City are not deceptive, there is a fair chance of an early abandonment of the horse system. We recently, by invitation of Mr. Sutro, the president of the North Beach lines, and Mr. Sessions, of the Electrical Engineering Company of this City, who have furnished the apparatus, went out to see a heavy car moved over the company's line by means of storage batteries, and must confess to some surprise, not only as to the car's performance, which was perfect, but also in respect to certain economic points.

The most remarkable feature is the elimination of grades in so far as power is concerned. The controlling devices, which are the invention of the Electrical Engineering Company, act automatically, and, as the Watt meter shows, utilize the gravity of the car in descending grades. This is done, as remarked, automatically, and it is strange to see a car climb a grade, and then descend at the same speed, without brakes and without adjustment of any kind, the Watt meter reversing as soon as the car passes over the crown of the grade.

The Electrical Storage Company, a separate organization that is supplying the batteries and apparatus, can certainly be credited with temerity in setting out in competition with powerful competitors in this line of electrical development.

We are not at privilege of saying anything of the technical features involved in the machinery and batteries, as these are the subject of pending patent applications in this country and in Europe, but trust that in this, as in some other arts, our corner of the world can claim a creditable place in the progress of the day.

ELECTRIC NOMENCLATURE.

The editor of *Industries and Iron* makes a vigorous attack on electric terms as commonly employed, which is discouraging, because no other branch of applied science has met with so much nursing in its nomenclature as electricity, and one would suppose that here at least was logical relevancy. An advantage of this otherwise almost useless controversy is that it is a foremost means of analysis. In order to determine whether a name is right, the nature of the thing named must be critically considered, but here are the views of the editor of *Industries*. Speaking of the Chicago Congress, he says:

"In nomenclature they will probably have little weight, but they would be a great boon if they lessened the use of a few loose expressions that are now in common use. One of these is the barbarous term 'voltage.' 'Potential difference,' or 'difference of potential,' is long and cumbrous, and P. D., being a contraction, of course sounds vulgar. 'Electromotive force' is also long and cumbrous, and is, strictly speaking, wrong, as the term ought to be applied only to the rate of fall of potential, not to the difference of potential of two points. In statics the force, or, more fully, the force per unit mass, at a given point is equal to the rate of decrease of potential. In magnetism the magnetic force, or magnetic force per unit pole, is equal to the rate of decrease of the magnetic potential. In electrostatics the electric force, or electric force per unit charge, is equal to the rate of decrease of electric potential. Maxwell sometimes calls this the electric force, and sometimes the electromotive force, but he also uses the term electromotive force when he means the line integral of an electric force, or a difference of potential.

This horrible confusion is universal now, and electromotive force is always used to denote what is neither a force nor a force per unit charge, but a potential. This confusion has been fatal to the introduction of clearness of ideas as to magnetomotive force, which has, of course, been confused with magnetic force, so that we have now a double confusion.

Still further confusion has been introduced by a few people insisting for no obvious reason, that the potential of, say, a cell relates to its terminals, while the electromotive force refers to the complete circuit. This is, of course, only confounding matters more. The word voltage was first introduced to denote the pressure for which an incandescent lamp is intended, apart from the pressure at which it is actually used; but, the average loose thinker now uses it to denote pressure. It is a barbarous word, and is not formed systematically. What is the objection to 'pressure'? It has the merit of fitting in with 'current,' 'resistance,' 'capacity,' 'charge,' and 'quantity,' which are all based on the hydraulic analogy. Of course, some

people may object to the hydraulic anaolgy; but they must remodel all the other terms if they wish to be consistent.

Current strength, or strength of current, is another barbarism. The electrical terms are based on the water analogy, and the current is the rate of flow of electricity. Current strength is nonsense. The current can vary, being large or small, but two equal currents cannot differ in some quality called strength. What is the difference between a current and its strength? This loose expression is used by electricians from the highest to the lowest."

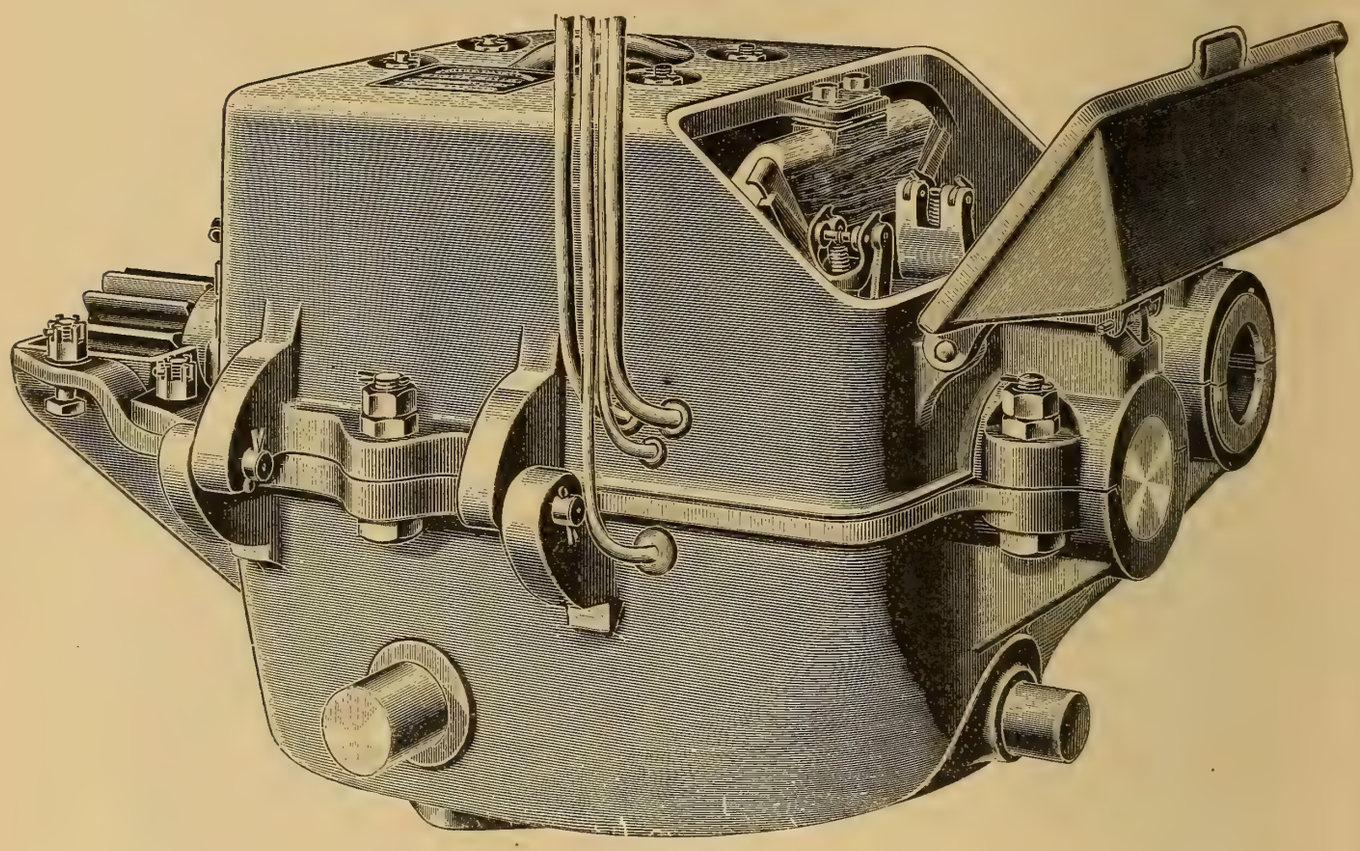


FIG. 1.

ELECTRIC MOTORS FOR STREET RAILWAYS.

THE GENERAL ELECTRIC COMPANY.

The evolution of constructive design in electric apparatus follows as fast as the science does in its technical phases, and for a wonder too, when one considers the impediments to be overcome. In the case of car motors, for example, there is the problem of mounting them so as to resist the concussion and jar of axles, which the motor must in a measure follow and partake of, in order to maintain the mesh of gearing, or to form mechanical connection with the axles. There is the problem of protecting, in a storm of dust, accurate and

sensitive parts that do not permit exposure, and still allow easy access to everything in case of wear or derangement. There is also a want of symmetry in the shape of operating parts that baffles the designer in his attempts to secure some kind of contour that is not "distressing," and further, a problem of weight to be dealt with.

The drawings herewith, which show two views of the General Electric Company's latest design for these motors, will illustrate some of the difficulties to be dealt with, and how nearly "har-

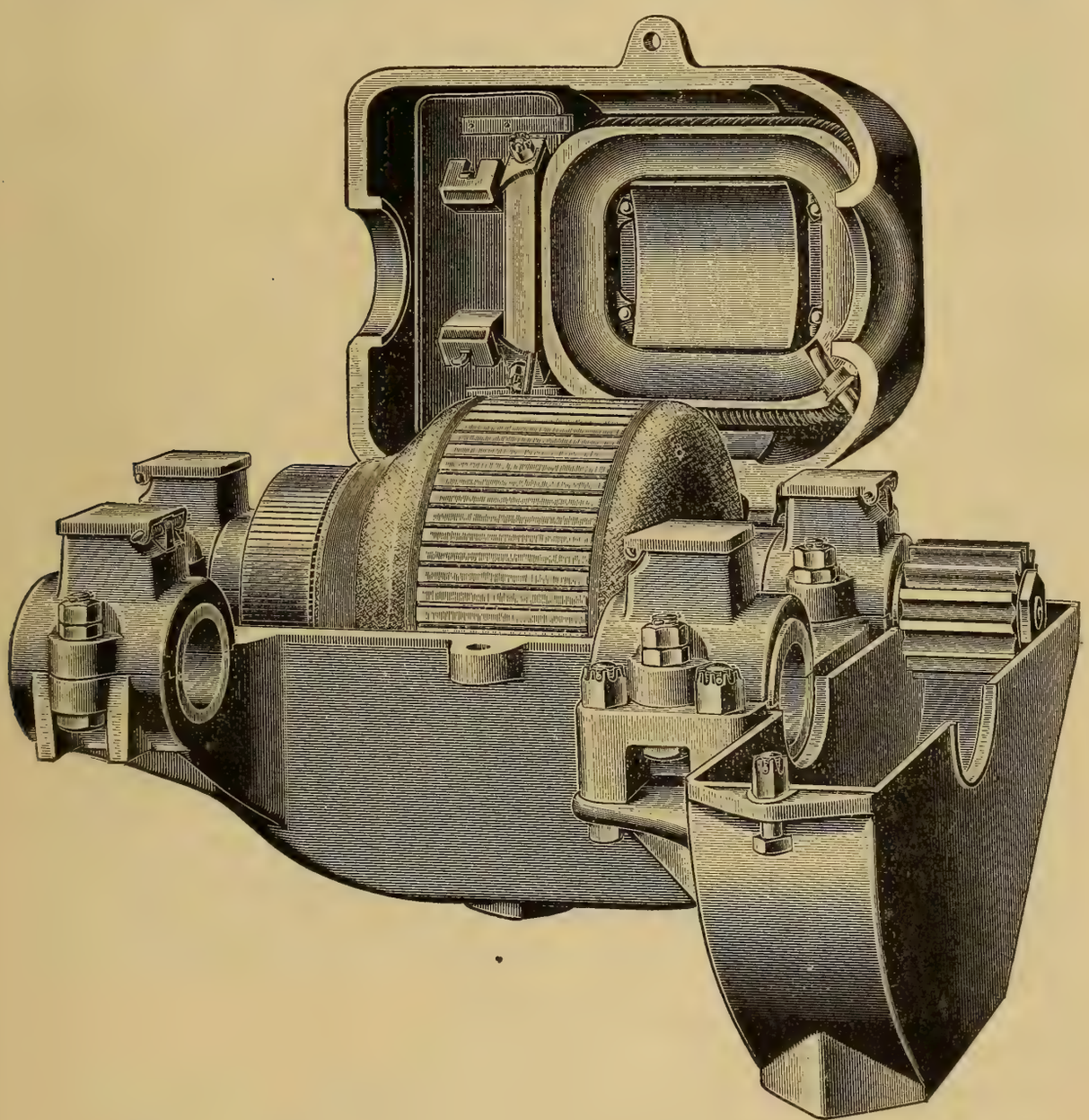


FIG. 2.

mony" can be worked out by assiduous effort. The design is for a 25 horse power motor of the four-pole type, and is less in weight than 15 horse power motors formerly in use for street cars.

The following extract from the descriptive matter issued by the Company covers the principal points aimed at in the design :

"This closing of the motor so as to make it water and dust proof has been rendered possible by its superior design, and the liberal use of copper and the best grade of steel in its construction, whereby the heat generated in the motor has been materially reduced. The motor, even when closed up as it is, runs much cooler than previous motors that were entirely exposed. It can be taken apart with the utmost facility. The top frame is hinged on to the lower frame, and with its proper parts weighs only 350 pounds. On the removal of only two bolts it can be thrown back completely out of the way of the armature, or by the removal of the hinge pins the top frame can be lifted into the car, or by moving the nose plate forward the motor can be swung upon the ring axle as a hinge so as to be accessible from the pit, the top field then being swung on its hinges still lower into the pit, in which position the armature and field spools can be easily removed ; or by the removal of the top of the gear case and two axle caps the motor can be lowered as a whole into a pit. The armature is short and can be lifted through an ordinary trap door. The motor can be handled either inside the car or from without with almost equal facilities. On opening the lid over the commutator, as shown in Fig. 2, easy access is had to the whole width of the commutator and brush holders, the latter being of the simplest possible construction and easily operated with one hand. There is also plenty of space to permit of the pit of the motor being reached. The bottom of the armature is two inches above the pit of the motor, so that it is not liable to be injured by articles falling inside of the motor frame. The construction is such that it is practically impossible for any grease to get inside of the motor.

The armature is similar to that used on the well-known W. P. motors, and is made both in the Gramme ring armature and in the drum form. The drum winding has been carefully studied, and the many objections to the various kinds of drum windings that have been from time to time put upon the market have been carefully guarded against. A thorough trial has demonstrated that the drum winding of this motor can be relied upon. It will be free from the danger of burning out at the ends, heretofore common with this kind of winding. The Gramme armature and drum armature are interchangeable."

Those who think that electric lights do not generate heat should visit the dynamo room of the great station on Stevenson Street, in this City, when several thousand lamps are aglow together. It is an example of the strength of aggregation. A dozen lamps evolve but little heat, there is discomfort in a hundred, but a thousand suggests Yuma in July.

MINING.

NOTES.

A summing up of the tailings product on the Comstock, from 1871 to 1893, is set down at 2,675,825 tons, and the profit in their reduction at $2,520,058, or about one dollar a ton. In 1892, 104,058 tons of ore was produced from the Comstock mines, the value of which was $1,560,923, the total cost of mining, milling, and transportation was $1,869,188; which shows an unprofitable and losing business. The difference was, in part, made up by working tailings, the profit being $14,515, that is, this much of $308,265 was made up. It is difficult to see, under these circumstances, what makes the shares in such mines of any value whatever, supposing all of them to be in the same condition.

The Australian *Mining Standard* says the issues of the Australian mints was $101,167,950 last year, $17,000,000 of this amount was to replace worn coins, of which $14,000,000 was returned to the mints during the year. The cost of the work is given at 650,000 pounds sterling, or about $3,250,000, which must be a mistake of one cipher we think. Certainly it cannot cost over 3 per cent. to coin money, gold at least, which must have been the main part. During the late financial "cyclone" in Australia, mining securities stood better than land, and a result will be more confidence and activity in the mining industry for the future. Every year, excepting always the Comstock mines, there is some progress made, in all countries, towards the conversion of gold and silver mining to a stable industry. In the past this has not been possible, in the future it may be.

Mr. I. A. Edman, of Plumas County, in this State, has given a great deal of research to what may be called the minute conditions of gold extraction. He has been in this City for some time, and permitted those interested to examine a collection of microscopic examples, prepared by himself, that are a revelation. The examples are magnified to a scale of fifty, and cannot help affording a good many useful suggestions to people engaged in concentration as well as other processes of extracting gold. The main object of Mr. Edman's researches is to devise means of securing fine gold, the particles of which are too small to follow the laws on which both concentration and amalgamation are based. Some of the

specimens are beautiful when magnified, and none of them show the forms and disposition of the metallic particles that is expected or imagined. The diffusion of gold, in quartz for example, is such that its existence suggests it as being an elementary part.

Mr. A. C. Hamilton, of Virginia, Nevada, it seems has been receiving a salary of $2,500 a month as a mine superintendant. This is $30,000 a year, and more than the President of the United States received down to twenty years ago. This salary is paid mainly out of assessments, and the wonder is what the services are that are so peculiar and important as to call for this price. There is an assistant too with $18,000 a year, so the service costs $48,000 a year for five mines which Mr. Hamilton superintends. In thinking over the history of the Comstock mines in late years one is amazed at a credulity and forbearance that has permitted the destruction of a property that might to-day stand among the greatest of our industries, and in searching after causes one need not go farther than the speculative returns of twenty years ago. It would be much better for all concerned if the Comstock Lode had never returned more than ten per cent. a year on invested capital. Then it would be permanent, and a lasting industry.

Mr. E. D. Peters, a well-known authority on copper smelting, contributes to the *Australian Mining Standard* some facts respecting copper mining and reductions at the Atlantic Mine, in Michigan, that will form a puzzle for those who want to show the dearness of American labor. It is claimed that, at the mine above named, all the expenses around the mine, including mining, sorting and reduction, are 84 cents a ton. Loading and carrying the ore three miles costs 3.3 cents a ton, crushing and concentrating is 25 cents a ton. Refining, and sending to market 1,500 miles, added to the former give a total of $1.33½ per ton of ore treated, and the profit was $50,000 on 1,851 tons of copper. At the Oscola Copper Mine the charges above named amounted to $2.62 per ton. The Editor of the *Standard* thinks this far exceeds the results attained in this country, and it no doubt does. The wages in the Michigan mines are something over $2.00 a day, and less, no doubt, than are paid in Australia.

We have often spoken, not disparagingly but in doubt, respecting the Caminnetti law, and special laws, affecting hydraulic mining in this State, and the views presented have been confirmed by the

facts. In six weeks after the newly-appointed debris commission was appointed by the Government, no petitions had been presented by the miners for licenses to open and work their mines. The reason is not far to seek. The procedure is not one to be easily understood, besides there is a want of means to carry out works even if miners knew what the works should be or what is required. Col. Geo. H. Mendell, and the other members of the commission, have visited the mining country on a tour of inspection, and they are, no doubt, equally with the miners undecided as to what will be required to restrain the debris. A new law like the present one cannot be set in action at once, commonly a good many years are required for that purpose. If the whole of the special acts of every kind had been repealed it would have done more good.

The Germania Lead Works, in Utah, owned mainly here in San Francisco, are extending their plant, and have contracted with the Vulcan Iron Works, in this City, for two Buckner furnaces, the cylinders of which are 102 inches diameter, 22 feet long, capable of receiving charges of 12 tons each. These cylinders weigh 23 tons each, and will add immensely to the reduction capacity of the works. It is encouraging to see at this time such an addition made to mining and reduction plants, and gratifying to see the orders placed here for the new work. The Vulcan Iron Works seem to have retained their full share of business in the specialties to which their attention has been given for some years past.

The report of the Treadwell Mine, in Alaska, shows that the earnings of the past year were $385,614, of which $375,000 was paid out in dividends. This was done on ore yielding only $2.13 a ton. 237,235 tons were crushed at a cost of 44 cents for milling and concentration, mining 60 cents, chlorination 17 cents, general expense 1.4 cents, total for all $1.35 a ton. The mill, on Douglas Island, has 240 stamps, and is the largest one in the world. It was built by the Risdon Iron Works, of this City. The working force consists of 130 white men, earning from $3.00 to $6.00 a day, and 40 Indians at $2.00 a day. It seems incredible that a mine producing ore that assays less than $3.00 per ton should return a profit of 7.5 per cent on the invested capital, situated as this one is, at a distant point far removed from sources of supply, and in an inhospitable climate.

COMMENTS.

Wheat and steel are one cent a pound, or sold at that price recently. The prices of all staple products are on an average of twenty-five per cent. less than a year ago, and in many cases are far too low. It is the reaction due to inflated prices, and a reminder that economic laws are not amenable to the will or choice of men. It is a misfortune to have anything sink in price below the cost of producing it, and in the case of a necessity of life, like bread, must lead to wide economic disturbance. The farmer is only the man in the front rank. He meets the first attack, but behind him comes the whole commonwealth who must suffer accordingly. To say that the present low prices are a result of good crops, or "supply and demand," which is as far as people look into the problem, is not true. It is an inability to "demand" or buy bread. People have not means to purchase and use steel and wheat. A general debility born of a false policy and procedure, and the violation of economic laws that ought to be as plain as those pertaining to mechanical forces.

The Reading Railway failed to reorganize, and no one but shareholders and bondholders care much for the fortunes of that wrecked corporation. Twenty years ago it was one of the most sound and permanent properties in the United States. The shares were held in small quantities by thousands of people about Philadelphia. The earnings were moderate but sure. A control of the anthracite coal trade put speculation in the heads of the managers, and they set out to "cinch the people." The machinery of coal distribution, down to the smallest dealers, was bought in or crushed out, coal lands were purchased, and all affinity with public interests was cut off. Things went on successfully for a time, but the turning point came and the people conquered. The Reading lines went into the hands of a receiver. Rascality against the public was as usual accompanied by rascality against the company, and for twelve years past the whole matter has been a disgrace to our industrial and commercial interests. The last fiasco was a scheme to control the New Jersey Central and New England coal-carrying lines, which failed, as it ought to have done.

The Orange Belt, a well made up and excellently printed journal, comes to hand with a very complete resumé of conditions and events in the southern counties of the State. The various towns are each spoken of separately, and the most striking thing of all is the proscription of liquor selling in many of them, and very nearly proscription in a good many more. Whether the liquor traffic breeds disorder, or disorder breeds the liquor traffic, or the two things are parts of a whole, it is not easy to determine, but that they exist together, like the Siamese twins, goes without saying. The number of bar rooms is a tolerably constant exponent of the number of shiftless, unreliable and idle people, also is a measure of crime in a community. We are not believers in the efficacy of prohibition laws, except as such laws can force the liquor traffic to become responsible and respectable. This is what was done at Gothenberg, in Sweden, by what was known as the Gothenberg law, and the same thing can be done elsewhere.

Mr. Rothwell, of the *Engineering and Mining Journal*, continues to urge an international clearing house to settle the silver problem, and is, no doubt, discouraged at the small progress made in getting this idea hammered into the popular understanding. Money must sometime become a matter of international agreement, as many more things will later on. International postage rates became a necessity, but no more of a necessity than uniform coinage will be before long. The chief obstacle now is that patriotic sentiment that conceives of everyone as an enemy who lives in another country, a narrow bigoted view supplemented by a want of confidence in one's own country. There would be no difficulty in putting into money circulation all the silver in existence, and in maintaining some agreed proportion of value in respect to gold, if the commercial nations would join in carrying out the scheme proposed by Mr. Rothwell, but it will take a decade of effort to reach an understanding of what is proposed.

We have always thought that the election of the Hon. Warner Miller to the presidency of the Nicaragua Canal Companies was a mistake. Some one less intimately connected with politics, and more intimately connected with engineering matters, would command more confidence. A contemporary states that he is a director in the "Seven Stars" Mining Company, in Arizona, that offers to

sell 200,000 shares in that mine out of a capital of $3,000,000, at $5.00 a share, and guarantee dividends of 15 per cent. a year. If Mr. Miller's position and qualifications were such as to fit him for the presidency of the Nicaragua enterprise, this guarantee could be divided by two, and possibly by three, and then find plenty of purchasers for the stock. It seems, however, that the mine was bought for $450,000, of which $200,000 was paid, so the shares offered, although only one fifteenth of the capital stock, represent five times what was paid in. This is a kind of financiering that might well bear another name.

We think the near future is to bring about altered opinions respecting land securities, or agricultural loaning of money. Land may be, when properly estimated upon its producing power, an ideal security, but not much of it is appraised in this way, the values being taken on circumstances as unstable as apply to any other property, and indeed more so. Out of $50,000,000 loaned out by the Australian Joint Stock Bank, $35,000,000 was on "pastoral" security, $680,000 on mining property. The latter proved the better security, and as it has done in other cases in that country. Just now the mining industries are stable in comparison with the "boomed" land securities, and the same thing might be said of sections in our own country. Land has become a principal implement in the hands of rogues and speculators, who understand human nature and avail themselves of the *penchant* people have of getting an "estate."

The present turn out of miners in England is the strike of all strikes. The coal section, it is claimed, involves 280,000 men. The arguments against a proposed reduction of wages, amounting to 16 to 18 per cent., are that it is unjust and uncalled for. We cannot enter upon the facts, but it is a comfort to know there is a reason and argument in the case. These things are sometimes dispensed with. Broadly stated, the coal owners are very rich, and the industry is saddled with other charges besides wages that should be first removed, or removed at the same time that wages are reduced. Wages are the easiest to attack, and always become the first means of retrenchment. The men look on this element as the main one, and owners regard it as a disagreeable necessity that lies between the coal mines and their profits. The proposed reduction will, we think, in the end be taken from some other things as well as wages.

There are reports that Salton Lake is filling again this year, if so it indicates that a permanent channel will be formed unless barred out by artificial works. It is true that such natural reinundation is almost without precedent, but the Colorado River is as nearly oblivious to precedent and all the rules that govern common rivers, as can be imagined. There is, besides, a possibility that a redundant population thereabout, at some remote time, turned the river out of its natural channel, or diverted a part of its waters, so new channels were formed. If the Salton basin could be permanently filled it would afford an experiment in meteorology worth a good deal, and furnish matter for a world of learned observations and essays, besides creating a vast area of arable land.

The *Empire of Finance and Trade*, a New York journal devoted to statistics and finance, estimates that the people of the United States are paying to the capitalists of Great Britain, interest on two billion dollars, amounting to $80,000,000 a year. If this is correct, and there is no reason to doubt it, some explanation is required respecting the claims made of the enormous wealth of this country and as to where this wealth is disposed of. For a country with a false system of commerce, as many people claim, the British seem to flourish very well. Their investments are all over the world, in some countries vastly more than here, and the stream of gold to London pours in from all directions. Other countries may have the wealth, but certainly Great Britain has the cash.

The most obvious thing of all pertaining to the silver problem is that if the proportion to gold is set too high, gold will be sent out of the country to purchase silver at lower rates abroad. If, on the contrary, the value of silver is set too low, then silver will be sent out of the country to purchase gold that can be sold here at a profit. This is the Gresham Law, and is about as obvious as the law of gravitation. It is superflous to be writing and stating such a thing at this day. From 1790 to 1834 the proportion of gold to silver was fixed in this country at 1 to 15, or about 6 per cent. more than the market price of silver, and gold coinage ceased. In Europe silver could be sold for 15.5, and of course the silver went there to purchase gold. The whole of this silver hubbub seems to be a desire to have an artificial

value created or attempted, a tariff on silver, to so call it. Since 1834 we have had gold as a standard for our money, and to talk of other countries forcing this standard upon us is an incorrect statement of the case.

The American Line are having built, by Messrs. William Denny & Co., of Glasgow, a freight steamer of 9,000 tons burthen called the *Southwark*, the largest of the class ever produced. The ship is now launched, and to be in commission by the coming winter. This will require a new act of Congress to secure register for a foreign-built ship, and the question arises, why was not the vessel built in this country? If not prepared to construct of this size, which is hardly to be assumed, two smaller vessels could have been made, but there is not such excuse. The Union Iron Works here would have taken a contract of the kind and executed it, so could other yards. The main thing was, no doubt, the cost of material. Skill and implements are portable, and there need be no lack of them. We believe that were it not for our antiquated Navigation Laws this, and all other vessels required, would be built here. These laws operate like the silver-purchase one—backward.

Mr. Raphael H. Wolff has written for the *Forum*, August number, the weakest paper we have seen in that publication for a long time, on "The Danger of Hasty Tariff Revision." He is evidently a protectionist, a wire manufacturer, who appears in the poorly disguised role of a tariff reformer. The main point of his paper is a rehash of the old wages' theory, he claiming wages are at least three times as high here as in Europe, and he does not see how the cost of production can be lowered unless it is taken from salaries and wages. The article is, as intimated, a disguised one and insincere, and is for that reason much out of place in a journal like the *Forum*, that assumes a high rank. If Mr. Wolff will deduct from his material and expense account what the tariff adds to these, and then divide his wages account by the wire produced, he will find the result not different from Westphalia, where he came from. We pay five dollars a year for the *Forum*, and expect honest goods for the money.

ENGINEERING NOTES.

We read in our foreign exchanges of an ingenious method of balancing hydraulic elevators by means of winding weights on tapering drums or fusees, also other new features which would not pass under that title here in San Francisco. When an elevator is to be "balanced" it is done by water, without any weights, ropes or fusee barrels. There is also mention of compound rams to adapt the piston area to the load to be raised in this manner, but less complete than the plant in the Palace Hotel here, constructed eighteen years ago, where the cages are balanced by water, and there are combinations giving four or more changes of piston area, or water consumption, to meet the requirements of varying loads. We suspect that elevator practice here is a good deal in advance of what it is in England, and other European countries.

President Hill, of the Great Northern Railway, is having water-tube boilers put in his fine steamers, now being built in Cleveland, and has chosen the Belleville-French type, which has been very successful in the French Navy. Either Mr. Hill is ahead in his plans, or else is venturing upon an experiment that may cost a good deal, but judging from his past history the former conclusion is the safe one. He built a railway "on business principles," as he expressed it, and is, no doubt, having his steamers built in the same way. Competing lines have drifted into a profligacy of management, or of financiering rather, that leaves the Great Northern Railway a wide margin of profit when there is a deficit on the other lines. Belleville boilers are being made in France by order of the British Admirality for a torpedo boat, which is to be wondered at, because there are several makers in England who claim to have high-class boilers of the kind.

We have several times cautioned the makers of gas engines here respecting what is known as the Day Engine, made at Bath, England, without valves, and receiving an impulse at each revolution. In answer to these cautions or suggestions we have been informed

that the method is "no good," which may be true; but it now appears that Messrs. Easton & Anderson, of London, one of the most conservative and able firms in England, together with other equally responsible people, have taken up the Day engine. It may be safe to assume that an idle stroke is required to clear the cylinders of spent gases, and that the two-cycle system alone will succeed, then again it may be a mistake, and if a mistake it means a commercial revolution in this manufacture, even if the greatest economy is not possible. Doubling an engine's power, and at the same time dispensing with its valves, and half the fly wheel, will go a long way in compensating some loss of heat or fuel.

Our readers have, no doubt all of them, seen comparisons between the *Great Eastern* and the *Campania*. The subject is one of much interest, because it answers the question for the first time in an intelligent way of "why did the *Great Eastern* fail? The following figures are from a late paper read before the Istitution of Naval Architects in Great Britain, by Mr. F. Edgar:

	Great Eastern.	Campania.
Length over all	692 ft.	622 ft
Length between perpendiculars	680 ft.	600 ft.
Depth moulded to upper deck	58 ft.	41 ft.
Register tonnage, gross	18,915	12,950
Draught, loaded	30 ft.	27 ft.
Passengers, first class	800	600
Passengers, second class	2,000	300
Passengers, third class	1,200	700
Indicated horse power	8,000	30,000
Full speed at sea	14 to 14.5	22 to 23

The horse power is the main point of difference. The proportion absolutely is 3.75 to 1, or qualified by tonnage assumed at 19,000 and 13,000 respectively, is 5½ to 1, and this agrees very well with the assumed rules for increment of speed in proportion to power.

Makers of pneumatic or elastic connected machine hammers in England, have beaten about over various fields of experiment, and now seem to have arrived at the point that such hammers attained in this country twenty or twenty-five years ago. One illustrated in *Engineering* recently, and made in Birmingham, is substantially the Hotchkiss hammer, made by Messrs. Chas. Merrill & Son, of New

York, for more than twenty-five years past, but is of less perfect design, because having a much larger air cylinder, and heavier reciprocating parts outside the ram and dies, which is not required and is detrimental. The English hammer has, however, the "Hackney" method of controlling the cushion, which in the Hotchkiss hammers was done by the speed. This is also an American invention, and we think some mention of this fact in connection with the new English hammer would have been only fair.

Some one in England has invented the old idea of "die turning" for shafts, "cutting it all off at once," so to speak. This has been tried scores of times. It is an idea of the unskilled, and one that is hard to combat by logical argument, but facts are against such methods. The most successful attempt we have met with was by a Frenchman in Massachusetts, who turned shafting by means of "rose dies," and a roughing tool to lead, and kept on for years. He was careful to buy clean iron, without veins of silica and "hard pins." The work was perfect and rapidly done, but if one visits that shop now they will most likely find this die turning a tradition, if not wholly gone to oblivion. The idea of forcing speed in metal cutting is a natural one, and the limitations are learned by experience. If one will stop to consider that in every process the speed is pressed to the limits of tool endurance, and that all are striving in that direction, and always have been, it should settle the matter.

It was a logical method to build the base framing of marine engines into ships, instead of providing heavy detached structures independent of the hull to be fastened down by bolts. It secures a better foundation for engines than can possibly be made in a detached form, is composed of thin plates forming an integral and almost necessary, part of the hull of a vessel just where it requires reinforcement. A profile of the framing of the *Campania* shows that her main kelsons rise to double depth under the engines, but in the older class of ships this method was not followed. It is a new feature developed by degrees, and has led to a good deal of contention in the navy, where a large part of the weight of engine framing was in this manner shifted from the Bureau of Steam Engineering to the Bureau of Construction, or to hulls. The engineers wanted to divide horse power by tonnage, and the constructors wanted to divide tonnage into iron.

On the Salingen-Remscheid Railway, in Germany, there is being built a steel viaduct 1,640 feet long, 351 feet high, the main span being a tremendous steel arch. The whole bears a strong analogy to some of the metal viaducts in this country. A foreign contemporary remarks that "the preparatory work is very extensive," and here will be the main difference between methods here and there, and it will be a safe venture to say that the cost of erection divided by tons of material will be double in Germany what the same work will cost in this country.

Among some other prophesies ventured upon in this Journal in times past, is one respecting impulse steam engines, or steam "turbines," as they are commonly called. We illustrated in No. 1, 1888, the Parson's engine, which at that time was in a state of evolution, and has since then passed through various stages of improvement. The latest experiments show that these engines now develop an electrical horse power with 20.3 pounds of water per hour, and this is as much as can be claimed for any piston engine connected directly to a dynamo. The last trials made were by Professor Kennedy, conducted at New Castle, England, in a very careful manner, including all the usual observations. It is time that more attention was given to this form of steam engines in this country. The Dow engine, which seems to be better schemed than that of Mr. Parsons, has not been heard of for some time.

We find, in the *Mechanical News*, the following rule for ascertaining the speed of steam vessels:

"In order to determine the speed of a ship, when the displacement in tons, length, beam and indicated horse power are known, ship builders and naval architects use the following rule: Multiply the indicated horse power by a constant, call this product A. Square the displacement in tons, and find the cube root of the result. Divide product A by this cube root; finally extract the cube root ot this last quotient. This will give the speed in knots per hour. The constant, above mentioned is 240 for ships about 400 feet long, and ranges down to 200 for ships 200 feet long."

This can be expressed in a shorter manner as follows:

$$S = \sqrt[3]{\frac{C\,H}{\sqrt[3]{D^2}}}$$

C being the constant, 200 for example. H = Indicated horse power. D = Displacement in tons. S = Speed in knots per hour.

Mr. Clement E. Stritton, the author of a "History of Locomotives," and an eminent authority on that subject, has visited this country, and finds a great deal to commend in our railway system. He has, no doubt, reached the sagacious conclusion that the Americans, like other nations, construct and operate their railways to suit the local conditions and circumstances of the country. A visitor here commonly confines his observations to the principal lines in the East, and rides in Pullman carriages, hence does not see all of our system, and not at all the worst side of it. Comparisons between countries in respect to railways is waste time, and serves no useful purpose. People get such accommodation as best suits them, and the service, as before said, fits the circumstances of environment.

The celebrated steel-making company at Sandvik, Sweden, have sent to the Chicago Exposition an unfinished hot-rolled plate of steel, 187 feet long, 12 inches wide, 3.75 millimeters or about 1/6 of an inch thick. They also send a cold-rolled band of steel, 650 feet long, 12 inches wide, about 1/8 inch thick. In the same exhibit is a finished band saw, 220 feet long, 12 inches wide, .068 inches thick. This is, no doubt, the most remarkable example in steel products that can be referred to. The Sandvik Works are where the Bessemer methods were applied almost as soon as in England, and where some of the most intricate forgings ever made have been produced. The Company send other exhibits to Chicago, but after the one above their skill in steel rolling cannot be questioned.

There has been introduced in England a feature in shallow draught vessels that needs some attention here, that of placing a propeller in a chamber or channel in the bottom of the vessel, so the shaft will be at or near the line of the keel, one half of the screw extending up into the chamber which tapers away fore and aft, so the water rises and leaves freely. It was thought that the air in the channel would have to be drawn out, but this was found unnecessary. The method is especially appliable on ferry steamers, and there seems to be no risk whatever in adopting it. It brings the draught of propeller wheels down to nearly the same as is required for paddle wheels, and preserves them from injury; also makes them accessible at all times, because when a vessel is still, the wheel will be half out of water.

LOCAL NOTES.

The proprietors of INDUSTRY, not without feeling in some degree the depression in the industrial affairs of the Coast, have nevertheless kept up to their assumed standard of a thousand pages of matter for the year. Some of our contemporaries indicate, by attenuation and otherwise, the effects of inaction, and it is not to be wondered at. There is in such a time as this, a falling off in what may be called technical activity, and a dearth of new things born of business progress, but it is a good time to "think" and economize in methods, implements and processes. It would be a pleasant thing to record prosperity and a widening of industrial activity, but even adversity has its useful lessons, and certainly the people of this Coast are as well off as their friends in the older states. Such panics come usually at periods of ten to twelve years, as credit and speculation outrun normal progress. The last one in 1886 was light, the present one is heavy in proportion, but will, let us hope, soon pass away.

The Southern Pacific Company has set out to conduct a war with the Oakland people, or rather both sides have declared war. The issue, unless all precedents fail, will be that the railway company will lose in the end. It may be years hence, but the time will come when the folly of such contention will appear. The worst phase of the matter is the undignified and provincial nature of such disputes, and of the causes that lead up to them. It is a good case for "arbitration," if it were not that a just decision is not wanted. Such a petty contract as that of giving a railway company the use of the streets on condition that some of the citizens could "ride free" deserves some such result as now appears. It is of a like nature with selling the water front to someone for a trifling consideration, and the whole matter is a result of electing incompetent people to administer public affairs. No one can find fault with efforts to regain equitable public rights thus bartered away. The fares on the ferries should be modified to meet the volume of the traffic, otherwise the present competition was inevitable, and should have been provided against long ago by reasonable concessions to the public.

There is a good deal in the present number concerning silver, mostly, or indeed wholly, other people's opinions, which are just now plenty. Everyone has views on the problem, warped commonly by a narrow premises or personal interest, which cannot be helped, and perhaps not blamed, under the ethics of modern politics and legislation. If there is not some gain in the stock of economic knowledge a great amount of effort will be lost. If one will notice the different opinions of people it will be seen that the principal points are a charge of selfish and malicious purpose on the part of foreigners, "gold bugs," or someone else, thus proving that it is discriminating aims and laws that are feared. People are not even charitable enough to admit that false economic views are at the bottom. Everyone is watching for some kind of "personal" motive in every act. Silver has fallen into what we call "politics."

Mr. A. L. Fish, of this City, representing the Worthington Company, of New York, has contracted for a pumping plant to raise water from wells at Sacramento to supply the city, and the work will, no doubt, be carried out in a complete manner. The wonder is that the people of Sacramento should so long have drawn their water supply from the Sacramento River, with all of its impurities, when the country around is a vast filter, and there was nothing to do but to "dig a hole" to procure pure water of any amount at the same level as in the river. There are, around the city, unwalled pits dug by farmers that afford a supply for irrigating purposes, the water flowing in summer within fifteen to twenty feet of the surface. The cost of the water is fixed by contract at 3.9 cents per thousand gallons up to 1,000,000, and above that 2 cents a thousand gallons, which is nearly no cost at all compared to some other rates that could be named.

There has been some public discussion respecting the removal of Arch Rock, a kind of out-sentinel for Alcatraz Island, in the Bay of San Francisco, but this we imagine will not be done, because it is not a great obstruction, and is a kind of beacon on the western approach to the island, also because the work would be one of great expense. The approaches are shallow and shelving on all sides, and while the amount above water could easily be cleared away, the shallow area below water would entail a large expenditure to deepen. The small rock half a mile to the northward is a different matter. It is low, dangerous in nature and position, and could

be removed with but little expense. The sides are perpendicular for a long distance below water. It is a crag, and the debris would fall down on all sides below the draught of vessels. We have surveyed a good deal about there—with fish lines.

The *California Architect* comes around monthly with a number of fine plates, well made up, finely printed, and a credit to the serial literature of this Coast, or of any other place. Architecture, it is true, involves in great degree the element we call, for want of a better term, "taste," and there is the farther fact that such a journal has for its readers only educated professional people, but making due allowance for this requirement one must concede a commendable skill, and care in the preparation of the *Architect*. The August issue contains a fine drawing of the proposed *Examiner* building on the corner of Third and Market Streets, in this City, from the designs of Mr. Willis Polk, Architect. The immensity of the building is almost the only feature we dare to remark upon. If constructed it will be the most remarkable building in the City, and this among many others that are remarkable.

El Primero (the first), a fine steam yacht constructed by the Union Iron Works, of this City, for E. W. Hopkins, is now lying at Sausalito, and is the finest piece of marine architecture of the kind that has appeared in these waters. We allude especially to the water lines and "business part" of the vessel. She is 137 feet long, 18 feet beam, 102 tons measurement, with triple-expansion engines of 8, 12 and 20 inches bore, 12 inches stroke, and steams 16 miles an hour, which is quite fast enough for any kind of service. The production of such a vessel shows the flexibility of the resources of our great ship yard, and is in some respects a higher evidence of skill than the building of a vessel of thousands of tons. *El Primero* has the distinction of being the only private steam yacht of the first rank owned and operated on this Coast.

The following is from *Industries and Iron*, of July 21st, of this year, and if correct, does not seem to have attracted much attention here:

"California is generally regarded as a happy hunting ground for Britons, and our countrymen resident in the 'Golden State' are nothing if they are not energetic. An English organization in

which there is not a tittle of American capital — the Los Angeles, Owens Valley and Utah Railroad Company — has recently taken a definite step towards completing the long-proposed railway from Los Angeles to Salt Lake City. It has given to a local firm the contract for the construction of the Mojave-Independence section of the line, 150 miles long. The section will cost £420,000, and it is to be ready for traffic within nine months. The necessary material will probably be ordered in England. The same company is constructing a canal, 110 miles long, proceeding from a point 16 miles above Independence to Indian Wells Valley. This irrigating waterway is intended to open up some 400,000 acres of land for settlements, which will be served by the new railway."

On another page in this issue we have some remarks upon the system of competitive rewards at the World's Exhibition at Chicago, but refrained from saying anything of the system adopted there for determining awards, because that would at once have led to a question of honesty in the judges. Since writing the remarks we are relieved of this embarrassment by reported rascality in respect to the sale of awards, or scheming to obtain them by unfair and dishonest means. In foreign comments on the "Thatcher system," of a single judge in the different departments, while possible venality is not charged, it was easy to see that it was thought of and apprehended. Let us hope, as a matter of national honor, this thing is ended, so far as direct charges, but the mischief is done to a great extent by a single rumor of the kind. Awards that carry with them a breath of suspicion are valueless. The appointment of the Hon. Boyd Thatcher as Commissoner of Awards was a mistake that may be remedied yet by turning him and his crew out of office, and substituting the old jury method if there must be competitive awards made.

Admiral Selwyn, of the British Navy, lectured last month, before the Academy of Sciences in this City, on the extraction of metals by chemical reagents, principal of which is chloride of sodium, or common salt. The fundamental proposition, to so call it, is that the diffusion or deposition of metals in lithic or other formations is affected by certain chemical combinations of which chloride of sodium is a base, and by parity of action or result such metals can be released or dissolved out, so to speak, by the same agents. This we gather as the general hypothesis or proposition, which is one for metallurgists and chemists. The subject is one to which the author claims to have given a great deal of study and experiment, with

what practical results we are not aware. As an abstract proposition, however correct in a scientific sense, it will not have interest here among mining people until practically demonstrated.

The *Olympia*, Government cruiser, has crawled out of her berth at the Union Iron Works, and felt her way around the bay impelled by her own machinery. This is no small matter. If the machinery in the *Olympia* was taken out and distributed in factories it would fill a street of them. A hundred steam engines for one thing, with hydraulic, pneumatic and electric apparatus that would equip an exhibition. All these things jammed into space not more, and perhaps less, than would be required to pack them for shipment on land constitutes a problem intricate, extensive and even incredible. These departments must be started and tried, not only separately but collectively. All are integral parts of a tremendous whole, which we call a modern war vessel. It is hard to realize the skill and effort required to call these agencies into existence. It is the acme of modern engineering, led up to by efforts of the highest talent in all countries, and its concentration in each. The wonder is that such a feat can be carried out at all.

The very emphatic decision of Congress against setting up a special value for silver in this country, and the equally emphatic repeal of the purchasing clause of the Sherman Bill, will, no doubt, result in an early increase of confidence and business. People can suggest and set up theories as they may respecting the cause of the present uncalled for panic in the financial affairs of the country, but all such causes can be narrowed down to a "scare" in respect to "prices by law," and repudiation of obligations thereby. That is the whole secret. Two billion of dollars invested in this country by foreign capitalists on a definite basis of values, or an international basis of values, was placed in jeopardy, or at least was thought to be so placed, and this capital, together with a much larger amount loaned or invested by our own people, was "called in" for safety. The fear was cumulative, urged on by those who want "fiat" or cheap money, until chaos came. The whole matter goes back to the myth called "legal tender," a power no government can enforce except as to debts incurred, and in this lay the difficulty. Now that illusion is out of the way we can go to work by legitimate means to increase the price of silver.

LITERATURE.

Journal of the Franklin Institute.

JULY, 1893.

This number contains three papers of value, the first one being the lecture of Nikola Tesla, before the Franklin Institute in February last, and subsequently in St. Louis before the National Electric Light Association at their meeting there, on the subject of "Light and other High-Frequency Phenomena." Mr. Tesla has easily the first place among the investigators in alternating current phenomena in this country, perhaps in the world, and this lecture may also, in many respects, be called the most interesting one that has been presented upon the subject. We have quoted from it several times, and nothing but a want of space prevented us from presenting the whole to our readers.

The second paper on "Present Development of Heavy Ordnance in the United States" is by Lieutenant W. H. Jaques, Ordnance Engineer, U. S. Army, who is, no doubt, as competent an authority on this subject as any engineer now living. Lieutenant Jaques was a member of the celebrated U. S. Gun Commission that visited all of the principal ordnance works of the world some years ago, and were treated with distinguished courtesy everywhere. Since then we believe the author has continuously pursued his investigations, and has had a prominent part in laying down and designing gun plants and gun manufacture in this country.

The lecture is a plain perspicuous account of modern practice in constructing heavy ordnance, and could not well be more, because all new ideas that promise increased effect are at once tried and put into practice or condemned. For our own part we fail to see how the world is any better off than if we had to use the guns of Gustavus Adolphus that were bound with rawhide thongs, and believe that a "Quaker gun," made of a pine log, is the preferable weapon of all, but such opinions must not detract from the ability displayed by Lieutenant Jaques, who has been instrumental in bringing American guns up to those of other countries.

A third paper, by Prof. Jos. W. Richards, on "The Specific Heat of Metals" is a good example of exhaustive research, such as is at this day applied in most branches of scientific investigation.

The definition of specific heat of a body is that it is the ratio between the amount of heat required to increase its temperature one degree, and the amount of heat required to increase the temperature of an equal weight of water one degree. The term "ratio" is used here in the sense of proportion and is not correct. Ratio is a "rate" of difference, not a difference, but there is a constant tendency to substitute this term for "proportion," as in the "ratio between gold and silver."

Molesworth's Pocket Book.

Messrs. Spon, the publishers, have issued a twenty-third edition of the above named work, without revision so far as we can see, and without need of it.

This pocket book of Mr. Molesworth's we regard as the most carefully compiled reference of its kind, if such comparison can be made, because there is no other of its kind, if we consider its convenient form, $3 \times 4 \times \frac{3}{4}$ inches, containing 800 pages of text. Of the subject matter, the most that can be said, and enough to say, is that among six or more reference books of the kind kept on our desk, "Molesworth" is the one of last appeal and first worn out. It is the most compendious, and at the same the most comprehensive of all. There is scarcely a subject connected with what may be called constructive engineering that is not included in a manner and under an arrangement that has been the study and work not only of the able author, Sir Guilford Molesworth, but of a score of others who have contributed, suggested and amended during the thirty years this pocket book has been in use. As a matter of personal opinion, there is no need of any other, for mechanical engineers at least.

Messrs. Osborn & Alexander are the agents here, and keep the books in stock. The price is $2.50.

The Importance of North Pacific Weather Stations.*

BY MARSDEN MANSON, C. E.

This paper is in a sense a corollary, and also, it may be said, a summing into practical form, studies that have engaged Mr. Manson's attention for many years past.

His lectures on the "Cyclone Belt of North America," and the "Atmosphere of Planets," delivered before the Technical Society of the Pacific Coast, in 1891–92, are in a degree preliminary, and in an equal degree tributary, to his present proposition to establish an observation station on the Aleutian Islands, in the path of the storm centers, or, as may be said, at the focal point of generation, at least where observed lines seem to converge as a foci of disturbance or low barometical pressure. Of this matter the author says:

"The line of maximum storm action lies across the continent between the 47th and 60th parallels.

The approach of these storms is first noted in the extreme northwest.

These storms may come from one of three sources.

1st. They may progressively come in from even the Asiatic coast.

2d. They may originate in tropical or subtropical latitudes, as do the West India hurricanes, and following the Japan current, reach our coast as the West India hurricanes do the European coast.

3d. They may, under favorable conditions, develop along either line and follow the general course."

Mr. Manson's proposition is that the University of California carry out a series of observations on one of the groups of Aleutian Islands, Tigalda, Amukhta, or Amchitka, lying in East Longitude from 165° to 179°, and North Latitude from 54° to 51°, which he maintains can be done at an expense of $10,000, with such aid as the Government would gladly extend in the way of providing instruments and apparatus.

These observations would be a proper function of the Weather Bureau, now unhappily transferred from the War Department to that of Agriculture, which no doubt means an end of any useful research of this kind, and possibly a conversion to what we call a political department. At any rate, the investigation of the phenomena of storms, which was only commenced on this Coast, seems to have ended where Lieutenant John P. Finley left it.

Mr. Manson's paper is accompanied by five charts, four of them showing the course of storms throughout the four seasons of winter, spring, summer and autumn, and one chart on which all of these lines are traced in four colors.

A glance at these charts shows at once that the observed meteorology of this country centers on this Coast and in the North Pacific. All besides is merely following and reporting the course across the continent, soon enough for the Middle and Eastern divisions of the country, but not soon enough for the Northern Pacific Coast.

Of the result of observations on the outlying islands, Mr. Manson says:

"The question of the cost of connecting the station at some time in the future by cable with the continent, need not now be considered. If it shall be demonstrated that the storms which devastate this continent—that the cold waves which cost human life, and that the hot waves which produce such terrible infant mortality in the great cities of the Western States and those on the Atlantic seaboard—that these phenomena can be foretold from a point 50° west of San Francisco, no consideration of cost will deter the telegraphic connection."

In respect to the proposed observations, Prof. Le Conte says:

"The fact that there is a general movement of the atmosphere eastward along the parallels 45°–60° N. lat. is, I believe, admitted. That storm centers are carried along with this movement across the continent, and thence across the Atlantic to Europe, is, I think, also certain. Many storms apparently originate on this line. But even when they originate elsewhere, as for example the hurricanes of the West Indies or cyclones of Indian Ocean, they move northward, northeastward, and generally eastward along the same line. If this be true, and if farther, as Mr. Manson believes and as seems probable, storms come to us from the Pacific Ocean, then evidently the importance of an observing station near this line and as far as possible westward, cannot be over estimated. I therefore most heartily sympathize with his proposition."

Prof. Soulé says of the same matter:

"I wish to place myself on record as entirely in favor of carrying out the work outlined in the paper. The expense would be trivial in comparison with the benefits derived and the lively interest created in the whole subject of terrestrial meteorology. I hope the scheme may be carried to a successful completion."

*Read before the Science Association of the University of California, April, 1893.

The subject, or the science it may be called, of tracing storm centers and defining in advance their force and course across the continent has become a practical matter of far-reaching interest, and the results are all and more than the most sanguine among the signal officers predicted when the scheme became comprehensive and was extended all over the country.

The principal field of observation, or the point of principal divergence seems to be north of Puget Sound. The extreme northwestern station at this time is a small island at the entrance of the Straits of Juan de Fuca, thus spoken of by Mr. Manson:

"This station, known as Tatooch Island, gives the first warning of the approach of a low area, which may bring devastating storms to this continent, the Atlantic Ocean and even Europe; or of a high area which may bring intense cold to half of the civilized population of the globe. Yet this station has an equipment of stations of the second order, and its telegraphic connections are unreliable."

The Relation Between Employers and Workmen.

BY MR. C. R. IORNS.

This is a paper read before the Mechanics Institute, of Manchester, England, in March 1893. The author, Mr. Iorns, brings to his aid in dealing with this subject a long experience as manager of engineering works in various branches of that industry, and is now manager of the Atlantic Works, at Broadheath, near Manchester, England, where a large number of skilled men are employed, and work on the American system in respect to hours.

A main characteristic of Mr. Iorns' essay is that it is intensely practical. The same remark applies to nearly all literature on the labor problem that has appeared in England. Reasoning is from facts instead of theories. The generalization, and often sophistical propositions and theories, dealt with in other countries have but little attention there.

The subject is treated there as a condition, not as a theory. This prevents, in a great measure, any comment on the paper that would be of interest in this country. The circumstances are different in many ways, but we cannot agree with the author in his view that the relations between employers and workmen should be closer or more connected. On the contrary think that such relations are, in a business sense, too close already, and so much confounded together that there is no determining where responsibility belongs.

If the labor of production was separated from material, expense and the normal profits of capital, or of a business, then a solution of the problem would appear. Let the workman be responsible for his work, and the employer for material and the conduct of the business, as is done under the contract system in many works in Mr. Iorns' district, then disturbance would cease. A true community of interests would appear, because the interests would be distinct in so far as the prosecution of a business, and identical in so far as success.

Continental Electric Light Central Stations.

BY KILLINGWORTH HEDGES, C. E.

This is an extensive quarto work, containing twenty-five folding plates and one hundred and forty-four engravings, showing the constructive arrangement and principal facts pertaining to the electric plants of more than fifty cities on the continent of Europe. It is not often possible, especially in Europe, to gain information such as is here given, and is possible only in the case of electrical plants, which are more or less of a public character, and not bound up by a fear of giving out trade secrets.

The stations represented and described are tabulated and indexed at the beginning, so also the plates, engravings, and subject matter, so that the station at any city desired, can be at once referred to.

It is a work that will, no doubt, meet with a wide circulation in this country, where there is much curiosity respecting Continental practice, respecting which there is but meager record in the English language, and a great deal that will be novel in dynamos, buildings, turbines, engines, motors and appliances. There will also be the wholesome effect of apprising people of the great advances made by German and Swiss engineers in the construction of such plants.

The greatest diversity is found in the steam machinery, both engines and boilers, but especially the former, which, on the whole, do not indicate a tendency toward particular types.

At Marienbad, in Germany, single-acting engines are employed, for a wonder, because such engines have not made much progress on the Continent, where there is more dread of high speed than in this country or in England.

The extent of the book precludes any notice of particular plants, and indeed of tables, facts and information, including a glossary of terms that make it a reference of commercial as well of high technical value. It is published by Messrs. E. & F. N. Spon, London, and Spon and Chamberlain, New York, price $6.00.

The Chilean Revolution of 1891.

The Navy Department has issued, through the Bureau of Naval Intelligence, an account of the Chilean Revolution of 1891, which is in many respects an unusual document, being a "history" covering the principal events in both naval and land operations in that unfortunate war.

The ostensible object of the work is to convey information respecting naval operations, and it will remain, no doubt, the most authentic record of the war, prepared in our language.

It contains Balmaceda's Manifesto of Jan. 1st, 1891, and that of the Representatives, at Valparaiso, on Jan. 6, with various reports of commanders on sea and on land. But little mention is made of the *Itata* affair, or the part our vessels had in the war. The work was prepared by Lieut. J. H. Sears and Ensign B. W. Wells, of the U. S. Navy.

The Sierra Club Bulletin, No. 3.

This club, as we understand it, is a Pacific Coast "Alpine Club" so to speak, composed of members who contribute papers on subjects connected with mountain topography and explorations into unusual and, hence, interesting places.

The present Bulletin contains three well written papers, on "Crater Lake in Oregon," "Death Valley," and "The Upper Sacramento Valley in October." The account of a trip in "Death Valley," by Mr. F. W. Koch, who was a member of the company of naturalists who explored the Valley in 1891, is extremely interesting. It is an often told story in California, and as one may say, a well-known place, because the great Borax Works are there. Continuous traffic is maintained, or was during the time the Borax Works were carried on.

The pamphlet containing these papers costs 25 cents, and can be procured from the secretary, Mr. Wm. D. Armes, in this City.

The Electric Transmission of Intelligence.

BY PROFESSOR EDWIN J. HOUSTON.

This is the third and final volume of what Professor Houston calls his "Advanced Primers" of Electricity. In reviewing the last former volume we found some fault with the title, and must do so now, in so far as to claim that it might be more pretentious and perhaps more relevent.

Professor Houston has done a very useful work in this series by going out into the bye-ways of electrical science, and gathering up the odds and ends, so to speak, and presenting them in an able and lucid manner.

His dictionary of electrical terms, coupled with unusual scholastic attainments, has made it easy work for him to treat upon and classify a large number of subjects, which, as before remarked, seem to lie outside the conventional field, and in doing this difficult, and at the same time arduous work he has placed his fellow investigators and the public under a great obligation.

This has been done without pedantry, and in a compendious form, so as to be within the reach of all. The three volumes, "Electricity and Magnetism," "The Measurement of Electric Currents," and the present volume, for three dollars is the cheapest literature, considering its character and rank, that has ever been published on electrical subjects.

The book is sent for $1.00 by the publishers, the W. J. Johnston Company, 41 Park Row, New York.

"INDUSTRY."

JOHN RICHARDS, EDITOR.

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MR. CARNEGIE ON THE SILVER QUESTION.

We have had occasion, in time past, to find a good deal of fault with Mr. Carnegie, and for nearly the same reasons now find occasion to commend his views on the financial problems of the present time in this country. By this we mean that his strong Scotch business sagacity was brought to bear in using the untoward fiscal policy of this country to amass a great fortune, to which he is entitled by every legal right, and, we will almost say, every moral right, because if by superior economical and business knowledge he can reap a harvest from our mistakes, he has done it in a fair manner, and is entitled to his reward, the more so because he is but one among many that have reaped similar advantage, and he has, besides, done a great deal of good with his wealth, which most of the rest have not performed or pretended.

Our purpose is to argue that Mr. Carnegie's views of the fiscal affairs of this country, proved by the circumstance thus briefly alluded to, are worth more than like views of fifty average Congressmen, and perhaps an equal proportion of merchants and bankers, because these are "of the harvest," and will in many cases draw a revenue from the misfortunes of the people.

Mr. Carnegie, in 1891, wrote for the *North American Review*, an article which he entitled the "A B C of Money," an ill-chosen and fanciful title for an essay of the strongest common sense and the

most truthful presentation of the matter since the time of his illustrious kinsman Adam Smith, who, one hundred and twenty years ago, in the *Wealth of Nations*, laid down the true conditions and laws that pertain to "money."

The views presented by Mr. Carnegie in 1891 have become good prophecy, and now with allusion to his former essay he resumes the subject in the *North American Review* for September, and we are constrained to print extracts therefrom, believing that many of our readers will be benefitted, even if they do not read the complete article in the *Review*, which we strongly recommend. Mr. Carnegie says:

"We see the woolen and cotton mills stop in New England; the blast furnaces closed throughout the South; banks and business firms failing to an extent before unknown, and hundreds of thousands of workmen idle, where before every one was employed. And while a few thousands engaged in business suffer, the sufferers among the wage-earning classes are already numbered by hundreds of thousands. The country has fallen from the apex of prosperity to the depths of industrial depression. Adversity has taken the place of prosperity; stagnation in business has succeeded activity; confidence has given place to distrust; and, as is always the case when business is disturbed, the chief part of the loss or suffering is falling, and must fall, upon the workingmen — upon the poor millions and not upon the rich few. The millionaire will cease to make money for a time, or perhaps lose some which he can well afford to spare. The business man, as a rule, will certainly lose part of his capital, but few in these classes will be beggared. Upon the millions of poor people alone will come deprivation, restricted comforts, poorer food and clothing, and upon many absolute want.

Such a disaster has come upon the country as has compelled the President to call in hot haste an extraordinary session of Congress in these startling words:

'Whereas, the distrust and apprehension concerning the financial situation, which pervade all business circles, have already caused great loss and damage to our people, and threaten to cripple our merchants, stop the wheels of manufacture, bring distress and privation to our farmers, and withhold from our workingmen the wage of labor; and

'Whereas, the present perilous condition is largely the result of a financial policy which the executive branch of the Goverment finds embodied in unwise laws, which must be executed until repealed by Congress.'

This, then, is what has happened, and answers the first part of the subject.

We now proceed to the second part, and inquire why it has happened.

In 'The A B C of Money' I made a statement to which I venture now to call your attention. I said:

'In the next Presidental campaign, if I have to vote for a man in favor of silver and protection, or for a man in favor of the gold standard and a reduced tariff, I shall work and vote for the latter, because my judgment tells me that even the present tariff is not half so important for the good of the country as the maintenance of the highest standard for the money of the people.'"

In respect to this quotation, and the present comment, we must contend that Mr. Carnegie has "gone over to the other side" completely in this matter. Protection, in the sense he employs the term here, its political sense, means simply the imposition of fictitious prices by law, and the silver problem, in the phase which he opposes it, is "protection" pure and simple, but this need not be argued here. He continues:

"The cloud then seen in the sky was not bigger than a man's hand, and some of my party associates did not approve of my regarding the tariff issue as relatively unimportant compared with the money question.

But I am disposed to think that recent events may have caused them to modify their opinion. I mention this not to show you that I was a prophet, for it requires no prophet to predict what was known to be certain to come, and financial men generally saw the cloud as clearly as I. It is referred to in the hope that you may be induced to hear me more patiently now, since I was right then.

Few working people know why this panic was certain to come upon us, and it is sad to say that if you had known what "money" is, and the laws which govern it, the country would have remained as prosperous as it was during the previous decade, because you would have spoken to your Congressional representatives in a way that would have prevented them from taking the action which has plunged us all into such distress.

The reason why disaster has come is this. Up to the year 1878 gold was our only metallic currency, silver was used only for small change, and was legal tender in sums not exceeding five dollars. In 1878, however, a bill was passed requiring the Government to buy not less than two millions of dollars worth per month of silver, and to coin it into money, thus adding to our gold currency, currency in silver, from which before we were entirely free."

* * * * * *

"The Government has ever since been trying, and trying in vain, to give a value to silver which it does not possess. It has gone exactly contrary to all the other leading governments of the world. Keen observers of affairs everywhere saw that silver was being produced in larger quantities and more cheaply than ever, owing to the discovery of new mines and to improved methods of mining and refining; and, therefore, that it was falling, and bound to fall in value. One government after another

stopped buying and coining silver to use for money. It is nearly fifteen years since all European governments have ceased to coin silver. Our Government alone (Mexico excepted) has persisted in buying millions of dollars' worth of silver every month, and for the last two years it has bought more silver than all the mines of the country have produced, and has issued notes for this silver which it has so far redeemed in gold. When the United States began to buy and coin silver there was not a mint in Europe which was not closed against it. Every student of finance knew that if it continued to buy silver the time must come when it would be impossible for the Government to redeem all its notes in gold, because the country was losing its gold rapidly, and adding every month to its notes. It was only a question of time, therefore, when the most far-seeing and prudent among financial and business men, both at home and abroad, would begin to take measures to secure themselves against the possible failure of the Government to pay its notes in gold, for if these ever were paid in silver only, this would mean a loss of probably one half of all their funds, so a few investors at home first began to make all contracts in gold and to exchange the bonds they had bought, which were payable in lawful money, for bonds that were expressly payable in gold. People abroad who had invested their money in our country did the same, while others decided that it was safest to withdraw all their money from our country, and so the whole world looked on in surprise, and foreign governments with joy, at the attempt of our Government to bolster up silver, and quietly began to drain our country of its gold, leaving us the silver, of which we seemed so fond. We might accept silver if we choose, but gold was the only metal for them. Since our silver legislation of 1878 began to operate, as it was bound sooner or later to operate, we have exported in five years and five months, from 1888 to 1893, three hundred and twenty-eight millions of dollars in gold, and received only one hundred and fifteen millions. And you have to note that gold has been taken from us faster and faster as we added to our stock of silver; thus, in 1890, we lost only twenty-four millions; in 1891, seventy-nine millions; in 1892, seventy-six millions, and in five months of this year no less than sixty-three millions have been taken from us.

Besides this, before we unnecessarily left the exclusive gold currency we had in 1878, and plunged into buying and coining silver, and thus poisoning our hitherto pure metallic currency, we always gained and added more and more gold to our circulation, for the United States produces more than one third of the gold of the world, and coined in six years, ending in 1878, no less than 254 millions of dollars in gold. Since we so unwisely introduced silver into our currency as money, the people and governments of Europe, who have kindly relieved us of our pure unchanging healthful gold, have also kindly allowed us to substitute for it 354 millions of dollars of blood poisoning silver.

It may be well just here to look for a moment at the financial result of our Government's brilliant speculation in silver. The advocates of silver purchases insisted that if the Government would only purchase more silver than all the mines in the country produced that the price of silver would rise. Now, so far from doing so it has constantly fallen. Some of the silver bought by the Government some years ago cost $1.20 per ounce, this month's purchases were worth only seventy cents. Taking all the silver bought by the Government, at the market price to-day, the nation has lost more than one hundred and twenty millions of dollars. If the Government were to sell its silver it would lose much more. All this money has been drawn from the people to be lost in unwise speculation in a metal which all other civilized governments had been wise enough to discard. Nor was there ever the slightest reason for the Government to abandon the gold currency and adopt that of silver, for the gold currency was meeting every want, and keeping the nation free from all danger of financial distrust; and especially was it placing upon other nations the risks and losses already seen to be impending from the fall in silver value.

It is, no doubt, pretty bad management to lose one hundred and twenty millions of dollars of the people's hard-won earnings. But this amount is trifling compared with the manifold greater loss that is falling, and must now fall, upon the people by the disturbance of business which has come upon the country through the introduction of silver into the currency.

The task undertaken by our Government is, as you see, to pay gold for all notes issued for silver, these notes increasing, say, four millions per month, and our stock of gold decreasing this year at the rate of twelve millions per month. Now any man can see that this could not go on very long. Doubts began to arise years ago, but when a new administration came into power last March of course the financial world was more anxious than ever to know just what its policy was to be, and gold, we have seen, began to be taken from us more rapidly than ever. The gold stock of the Government fell lower and lower, and at last the hundred millions of gold hitherto held in reserve was infringed upon, and a panic threatened. President Cleveland found it necessary to make a statement, which was of a highly-reassuring character. But strong as President Cleveland is upon 'honest money for the people,' and highly as he is to be commended for his unfaltering position upon this vital question, still the shrewd financial men of the world doubted his ability to control his own party upon the money question, and so distrust continued to spread, and the entire business of the country, simply for this reason and for no other, was shaken.

The excitement was already great when a wholly unlooked for act of Great Britain intensified the panic. This was the closing of the mints of India to the free coinage of silver as money. From time immemorial the 280 millions of people in India have had the privilege of going to the mint and getting their silver ornaments

exchanged for, or coined into, 'money,' this was 'free coinage,' and because of this they have always purchased silver bars with their savings, and, having no banks or any secure place of deposit in their huts, it has been their practice to go to silversmiths and have their silver fashioned into ornaments and securely welded on the legs, necks or arms of women and children. In times of adversity, or whenever money was needed, these ornaments furnished the supply. Now, this is all changed in a night. Their uncoined silver, yesterday good as 'money,' is to-day only worth the market value of silver as a metal; in other words, more than one third of the value of the principal savings of the people has been swept away. What caused Britain to plunge into this drastic policy, and thus surprise India and the world, you will naturally wish to know. The reason was this: silver had fallen till the money of India, which is all silver, had depreciated more than one third. India owes Britain enormous sums, and has to pay so much every year to her that the Indian Government and railways and other corporations could not meet the loss they had to incur in remitting gold. Besides this the British Army in India, about sixty thousand strong, and all the civil servants, were demanding to be paid in gold, as their families had to be maintained in Britain, the fall of silver had robbed them of more than one third of their wages and salaries. The manufacturers of cotton and jute in India were taking the trade of Britain because they paid wages in India in silver, and wages had not risen, although paid in depreciated silver. I found in Mexico the year before last, that it was just the same, the wages had not risen at all, although now paid in silver not worth more than seventy cents per dollar, facts which workingmen, and all receiving wages and salaries, should ponder. A further fall in silver was apprehended by Britain, because it began to suspect that the United States could not be imposed upon much longer, and would soon cease the experiment of trying to keep up the price of silver by monthly purchases, and hence Britain took the bold step of cutting loose from silver in India altogether, as it always had stood aloof from it at home. It fixed the gold value of the silver rupees, already coined in India, at sixteen pence instead of the original value of twenty-four pence. This was the market value of the amount of silver in a rupee when the decision to fix a gold value was taken. But to show you how uncertain the metal silver has become, please note that within a few hours after this value was published by the Indian Government silver dropped twenty-three per cent. below it. It was then worth only thirteen pence per rupee, making the silver in our dollar worth just fifty-two cents. This is the lowest value which silver has yet reached.

Another source of serious anxiety about the silver problem is the coming termination next year of the Latin Union, the members of which agreed to coin silver and receive it from each other upon the basis of fifteen and one half ounces to one ounce of gold. France, Spain, Italy, Belgium, Switzerland and Greece comprise this

union, and are bound to settle upon the gold basis for all their silver coinage which has found its way into any of these countries. It is estimated that Italy and Spain will have to pay France about thirty millions of dollars each, and Belgium about fifteen millions of silver coins at about double their value, involving a loss of fifteen millions and seven and a half millions respectively. How this is to be met by Spain and Italy is not clear, and what the future action of these nations about silver is to be is just as dark.

For all these, and other reasons, the civilized world has abandoned silver, and seeing the United States still buying it, and issuing therefor every month notes transferable into gold, it knows that the Republic cannot long maintain the parity of its gold and silver currency, and hence it stands waiting for the final catastrophe, meanwhile refusing to invest in the United States, or to buy American bonds or shares abroad. Since Britain forced India to close its mints to silver there remains no mints in the world now but that of Mexico which coins silver as money, and no nation which is compelled to buy the metal and let it lie uncoined except the United States." * * * * * * * * *

"You hear now and then from men who, however, are experienced in business matters, that our trouble rises from scarcity of 'money,' and that what we need is more money in the country; but I do not think there is one man of financial experience in the whole world who will not tell you that this is not so. If more 'money,' meaning thereby more 'currency,' would have prevented this panic it would never have happened, because the Government has gone on month after month for years adding more money to the currency. We have now more circulating medium per head than any civilized country except France, and France needs more than any other nation because its people do not use banks and credit. Money, as you know, is simply the article which we use for exchanging other articles, and it is only used for the petty transactions. When a man tells you that to issue more money would increase the prosperity of the people, it is as if he told you that the larger the game bag you carry the more game you will get; that the more food you eat after your appetite is fully satisfied the stronger you will become; that the more surplus flesh you can put upon your bones the better it will be for you. He wants you to believe that if you put your wheat in bigger bins there would be more of it; that a gallon measure can be made to hold more than a gallon. If the Government were to make 500 millions of dollars more money to-day it would lie useless either in the Treasury or in the banks, because it would not be needed for the only purpose for which money is needed, namely, to effect exchange of articles. And this would be the case even if gold lay in the Government vaults equal to the notes printed. The national system cannot absorb more money than it can use, any more than your system can absorb more than a certain amount of food, and if the Government keeps on issuing notes for silver month after month, the depression in every department of business will deepen and

widen just as the Government does so. The panic that has come upon us is the best proof of this. It is the monthly issue of more 'money' ('silver notes') that is its chief cause; and note this carefully that, although more money has been 'issued,' there is already less in circulation than in June of last year by more than seventeen millions of dollars. It is one thing to issue 'money,' but quite another thing to get the business world to take it and keep it in circulation. This it is not within the power of governments to do. Whenever confidence is shaken the more money the government puts forth the greater is the trouble caused. The United States just now, as to its currency, is like a man too fat and full of blood, that is, he is in great danger of apoplexy. What would you think of a doctor who should tell you that the patient needed more blood in his system, when the trouble is he cannot keep in active circulation the blood which he has now? Just so with our country. There is no active circulation of money through the veins of the nation. The financial blood is stagnant. The superabundant 'currency' lies almost inactive, and it already requires a premium to induce it to come forth from its vaults and circulate.

We return to the sole cause of the panic, which is that people cannot see how 850 millions of notes can be paid with less than 100 millions of gold, especially when the notes are rapidly increasing and the gold rapidly decreasing; *and they begin to doubt not only the ability but the sincere desire of the United States to pay all its notes in gold as promised. The answer to why it happened is, therefore, confidence in our money has gone — confidence, upon which all business rests.*"

The italics we have supplied.

Concurrent with this essay by Mr. Carnegie we have received a number of speeches and papers on the "silver problem," all of which sink into insignificance in comparison with his plain business explanation of what is really a business matter. We have no need of the rhetoric that reaches back to the Roman Pecunia, and dissertations on "Western Europe" with abstruse generalization. These things are not of the question at immediate issue, which is, can values be created from nothing by law?

Mr. Carnegie has not found occasion to mention such things as "gold bugs," "enemies to silver," "the creditor class" (which must mean the railways), and other nonsense of the kind. He comes "down to business," as he has always done, and deserves the thanks of business men.

RECENT IMPROVEMENTS IN WATER VALVES.*

BY J. RICHARDS, IN CASSIER'S MAGAZINE.

The drawings from Fig. 1 to 5 show some water valves invented by Mr. C. I. Hall, of San Francisco, California, and employed by the Cahill & Hall Elevator Co., for hoisting or elevator machinery, in their practice.

These valves were aptly described by the inventor in one of his first specifications as permitting the water to flow only in the direction intended, which is the leading characteristic of all the designs.

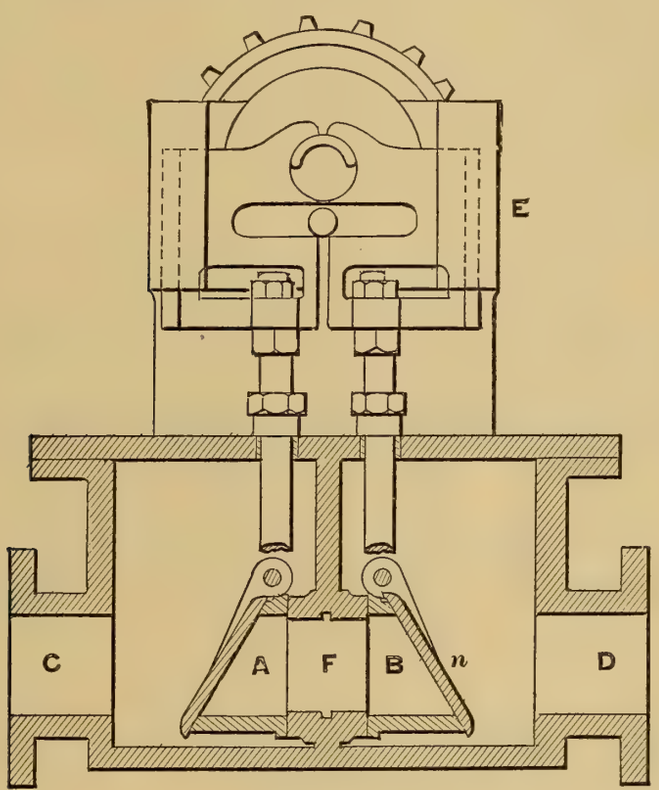


FIG. 1.

The company are makers of "hydro-steam" elevators, in which the impelling force is steam pressing upon the water, which actuates the hydraulic pistons, the water by reason of its inelasticity performing the required function of positive movement and "abutment," the same as in the case of common hydraulic elevators. The direct steam pressure dispenses with pumps, accumulators and so on, such as are employed when the price of water does not admit of its use from the public service.

The water employed in the hydro-steam system, while inelastic in itself, does not produce regular or safe movement when controlled by

*Copyright 1893, by the Cassier Magazine Company.

common stop valves, for the following reason: Suppose, for example, a load is being raised, and the cage is stopped on the way to receive an additional load, as in the case of passengers getting on at the different floors of a building. When the cage is stopped there is an equilibrium between the load and the steam pressure acting on the water, but when the valves are opened to go on, or to go down, the static pressure will be insufficient to sustain the new load, and the cage will suddenly drop until the steam rushes in to check the back-flow of the water and balance this added load. For this reason common stop valves cannot be employed.

In the case of removing a part of the load during a trip of the cage the same difficulty occurs. The pressure at the time of stopping the cage remains in the steam receiver, and when valves are opened this force is too great for the reduced load, and the cage is suddenly shot upward until the forces are balanced. The present

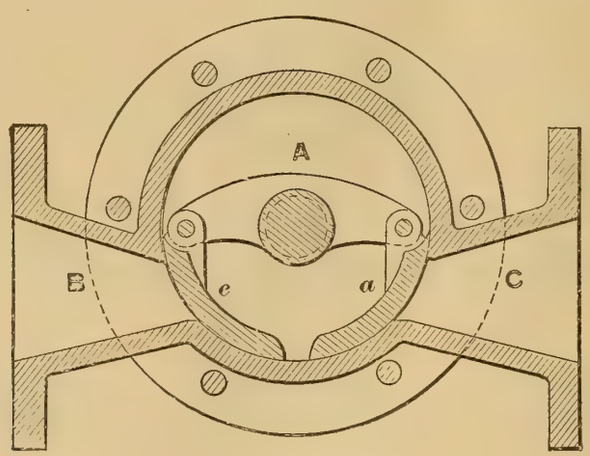


FIG. 2.

valves are employed to prevent this false movement, which occurs in the case of both passengers and goods.

Fig. 1, shows the form of water valves first applied to the hydro-steam elevators. *A* and *B* are two sliding valves operated by the mechanism at *E* so that either can be raised, the other remaining stationary. These valves are open the same as the passage *F*, but have on their outer faces two hinged plates *n n*, as shown in the drawing, that are free to open outward when the valve to which they are attached is opposite to, or covering the port *F*.

Assuming that the water is to flow from *C* to *D* to cause the elevator cage to ascend, and that an additional load has been taken on. The valve *A* is then opened, but no back flow can take place from the elevator ram or piston through the valve *B*, because of the hinged cover *n* forming a stop in that direction, but as soon as the

pressure through the passage *C* equals that in the passage *D* then the plate on the valve *B* raises automatically, permitting free flow from *C* to *D*. In other words, the elevator cage stands locked and still until the pressure balances the new or increased load, and then starts on the same as if no elastic medium was employed. The same thing occurs if the cage is ascending or descending. When the valves are in the position shown in the drawing they constitute a simple stop valve, preventing flow in either direction.

This form of the valves has been displaced by that shown in Fig. 2. Two hinged plates *a* and *e* are mounted on an oscillating bar *A*. When this bar is depressed at either end it opens the corresponding passages *B* or *C*, but no flow will take place either way until there is an equal pressure at *B* and *C*. In the position shown the valve stops flow in either direction the same as in Fig. 1. The

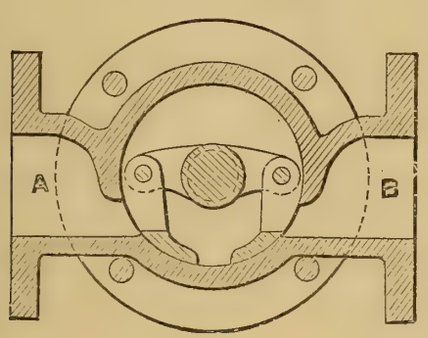


FIG. 3.

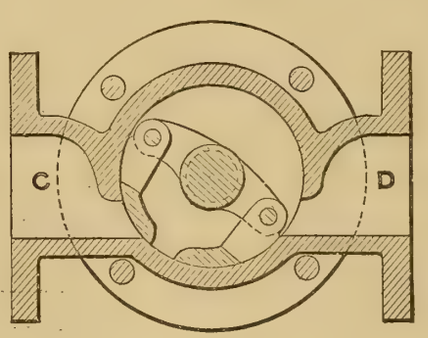


FIG. 4.

functions are quite the same, but the difference in cost is as one to three in favor of the valve last described.

The valve shown in Figures 3, 4 and 5 seems at first glance to be the same thing, but it is quite different in operation, and for a different purpose altogether. It is called an automatic stop valve, to check the flow of water to the piston or ram of an elevator at the extremes of the stroke, and is employed in connection with a main valve such as shown in Fig. 2. It will be noticed that when this valve is in its central or neutral position, as in Fig. 3, it is just the opposite of the one Fig. 2, being open both ways, offering no obstruction to flow in either direction, but when set, as in Fig. 4, it becomes the same as the one shown in Fig. 2, open to flow in one direction only.

Actuating tappets or stops of some kind on the elevator cages turn the valve to a close, right or left, at the extreme of the stroke, as seen in Fig. 4, so the main valve need not be disturbed until the cage sets out on a new trip. With a common valve there would be no way to

start back again; here, however, as soon as the main valve is opened the stop one is thrown into the position shown in Fig. 5, and when the tappets or stops that closed the valve are released it is returned by a weight or spring to the position shown in Fig. 3, ready to act the other way.

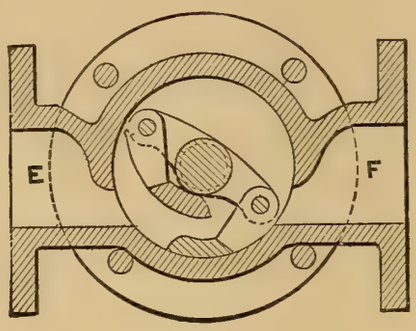


FIG. 5.

The hydro-steam system of operating hoisting and lowering machinery, employing in combination an elastic and inelastic fluid, gives rise to a number of problems of much interest, these valves being one, others may be dealt with in a future place. The subject is left here, first calling attention, however, to the valves in Figures 2 and 3 as mechanical expedients. It will be noticed that the rubbing surfaces operate under conditions that will keep them tight,

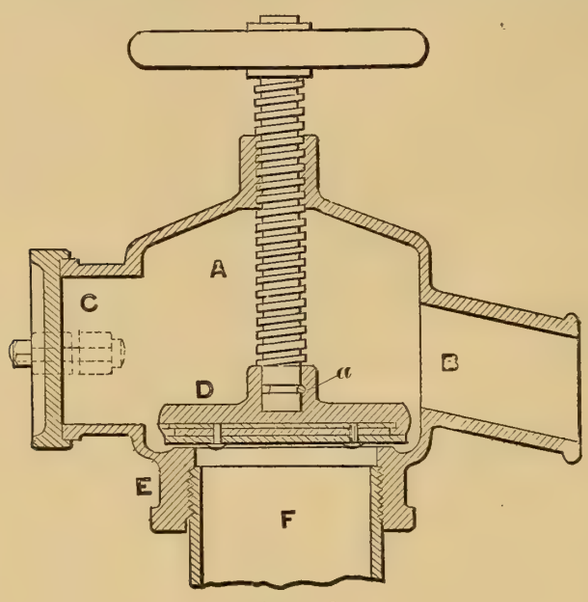


FIG. 6.

and that no non-corrosive metal is required, unless it be the stems that are packed. The cost is only one third as much as that of any of the common forms of stop valves, and the peculiar functions are thrown in gratis, so to speak.

We know of only one example that excels these devices in cheapness of first cost, and yet is good and serviceable; that is the

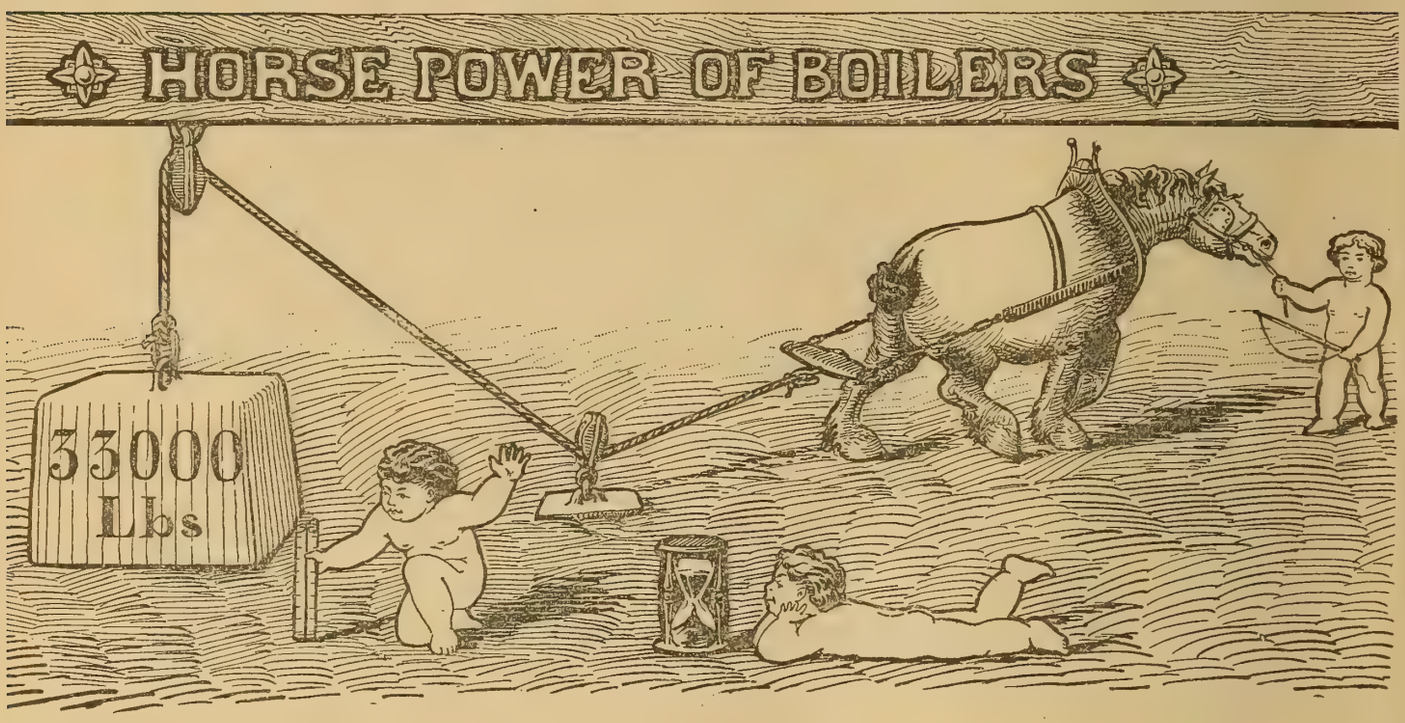
irrigation valves, as they are called, employed in Southern California, and shown in Fig. 6.

The main chamber *A* is rectangular in its middle section, the whole cast in one piece, with an oblong spout *B* at one side, a hand-plate *C* at the other side, and a nipple *E* to receive the water pipe *F*. The valve *D* is rectangular to prevent its turning in the case *A*, the face being made of leather riveted to a thin metal plate that slides in grooves in the bottom of the valve. The screw is held in the valve by a small pin *a*, and when this is removed the valve can be taken out through a hand-hole *C*, the main part of the water in the mean time flowing out at the spout *B*.

Scores of these valves are required on a large ranch or fruit farm, and are quite as convenient and durable as the common kind that cost four times as much. This is a kind of machine design calling for the highest ingenuity, seldom recognized as skillful. Praise is reserved for more complicated and expensive things.

ELEMENTS IN IRON AND STEEL.

Silicon, or glass, it may be called, is removed from iron as "slag" in smelting. It makes iron hard and brittle, and should be reduced to .08 per cent. Sulphur destroys the adhesiveness of iron, making it "red short," so it will crumble like dry clay when heated. It is eliminated wholly or as far as possible. Phosphorous has a like effect, but not in the same degree. 0.2 per cent. of phosphorous will not prevent iron or steel from being hammered and worked with safety. Manganese also makes iron short, but is an agent in converting iron to steel, producing hardness. Arsenic produces brittleness, the same as manganese and phosphorus, but imparts the property of chilling or hardening, the effect in this way, destroys toughness in the same degree. Copper injures iron, rendering it brittle when cold. Tungsten imparts both hardness and strength. Vanadium makes iron ductile, and suitable for drawing into wire. Carbon is the great qualifying element in iron and steel. 25 per cent. makes wrought iron, 50 per cent. makes steel, 1.75 gives the limit for welding steel, 2.0 per cent. is the lowest limit for cast iron.



HORSE POWER.

In the catalogue of the Abendroth & Root Manufacturing Co., of New York, whose steam boilers were noticed in our last issue, we find the above amusing vignette over the chapter on horse power of steam boilers.

The drawing does not need description. Those who have been puzzled over this curious and now almost mythical "horse power," will find here its elements set forth in a graphic way. The urchin in the foreground has charge of the "time" element, and as it consists solely in observation, he has taken the care to combine as much bodily comfort as possible in his part. The second actor having charge of "distance" or range, is more concerned, because he must signal some unit of height to the other attendants, but the most interesting figure of all is the motive power, the "Cornish cob," who as chief actor in the matter is not aware and does not care whether the resistance is a cart of coal, or what not. His business is to "pull," and science has no concern to him if the experiment winds up with "oats" and rest. If he gets the 33,000 pounds one foot high in a minute, he will have performed a horse power, and done well too.

The name "horse power" should now be quietly dropped from our terminology. The unit is useful, at least some unit is useful, and

33,000 pounds as good as any, unless it were smaller and corresponded with some other measure in our system. Confusion arises over the term in England, where there is "nominal horse power," meaning a certain cubic capacity of the cylinders of engines, or at most displacement of steam pistons, and consequently useless even as a measure of steam engines.

The dynamic horse power portrayed by the artists in the drawing, or some other more rational unit of the kind, is indispensable in rating motive power, because the smaller unit foot pound is inconvenient and calls for too many figures. 33,000 pounds is too large, and frequently calls out that anomalous term, "half a horse power," or less grammatically, a "half horse power," "quarter horse power," and so on.

If it were not for the hopeless attempt to alter an old custom, it is likely that the makers of steam engines and other motors would welcome a new measure of 1,000 or 10,000 pounds one foot high per minute, and leave out the equine part. This would call for a new term, and were it not for confusion with the weight of engines, "ton" would be the natural term, and 2,000 pounds a good unit.

We think this would be a good subject for international consideration among scientific people. It would consume some reams of paper, no doubt, and take some years, but certainly would in the end reach some more relevant and euphonious name for a power unit or measure.

THE NEW NAVAL STATION AT SYDNEY, AUSTRALIA.

BY MANFIELD NEWTON, C. E., SYDNEY.

Garden Island is situated at the entrance to Woolloomooloo Bay one of the principal ones with which Sydney Harbor abounds, and may be ranked third in importance in Sydney Cove, or to give it its popular name, "Circular Quay." Garden Island was one of the most beautiful and picturesque islands in Sydney Harbor, its rocky and hilly surface being a very striking feature, covered as it was with verdure, and being so near the main land and one of the busiest parts of the city, it was frequently used as a camping ground for boating men in their excursions.

About the year 1883 the Imperial Government asked the Colonial Government to appropriate a site for workshops, so that a naval station might be established in Port Jackson, and thus obviate

the necessity of sending the ships home to refit. An agreement was come to by which the Colonial Government agreed to cede Garden Island for such a station, and to construct and fully equip the necessary works there ; the Imperial Government, on their part agreeing to give up all title to certain property on the main land, consisting of land at Dawes' Point known as Dawes' Battery, one of the points of Circular Quay; the commissariat stores and Paddington Barracks in the City of Sydney, also certain land at Newcastle and Bathurst. These properties, it is claimed, represent good value for the whole expense the Colonial Government will be put to for constructing the naval stores. The cost of the work on Garden Island, which included the levelling of a portion of the land, was, up to the end of last year in round figures £190,000. It is asserted by the authorities that the total cost to the Colonial Government will be about £220,000.

The fact of the erection of this establishment in port Jackson ensures that the port shall be the Australian naval station of the Imperial Fleet, for all time. The presence of so many men of war here, and the repairs being carried on in the port, means the expenditure of a large sum of money in Sydney.

This agreement has not deprived the citizens of Sydney of their most attractive island, but it has necessitated its transformation into a very ungainly affair. About half of it has been levelled and made useful, but unsightly. Many-windowed stores built upon the levelled portions, give the island that utilitarian appearance, which unfortunately always appears to be at war with the picturesque.

It seems a pity that Cockatoo Island was not chosen as the site for these stores and arsenals, as it would have answered the purpose of the Imperial Government quite as well. On Cockatoo Island there are two docks, the Fitzroy Dock, which will take gunboats and the smaller cruisers, and the other the Cockatoo Dock, which will take the largest men of war, it being the largest dock south of the line, and one of the largest in the world. The choice of this island would have given greater satisfaction to the people of Sydney.

The works in connection with Garden Island are now approaching completion, and amongst other appliances are the huge shear-legs recently erected. On the 8th of July, a party consisting of Mr. Lyne, the Minister of Works ; Mr. C. W. Darley, the Engineer-in-chief for harbors and rivers ; Mr. Foxlee, the Engineer-in-chief for existing lines, and Mr. T. F. Houghton, the representative of the Worthington Pumping Engines, proceeded to Garden Island to witness a test load applied to the shear-legs.

These legs, which are known as 160-ton shear-legs, are the largest of the kind hitherto made, the next largest being, it is believed, at Cronstadt, Russia, of 150 ton capacity. They were constructed by Messrs. Easton & Anderson, of Frith, Kent, England, and erected on a foundation of concrete put in by the Colonial Harbors and Rivers Department.

The front legs are 137 feet 4 inches long, placed 45 feet apart at the base and meeting at the head. The legs which stand facing the wharf, are formed of steel plates half an inch thick and are 1 foot 9 inches diameter at the ends, and 4 feet 6 inches diameter at the centre. The two legs weigh about 24 tons each. The back leg is 187 feet 6 inches long, 5 feet diameter in the centre, and 2 feet diameter at the ends. It is constructed of half-inch plates and weighs 28½ tons. This leg is coupled by a band at the head of the two front legs, and from the same band hang the shackles, from which is suspended a large purchase block. To the shore end of the back leg is attached a large nut that traverses on a screw 54 feet in length and 10 inches in diameter, 3-inch pitch. This screw is worked by a separate set of engines, and by revolving, it thrusts out or draws in the back leg. When the back leg is at the outer end of the screw, the purchase block is plumb at a distance of 45 feet from the face of the wharf. The engines above mentioned are termed canting engines, and have cylinders 16-inch diameter and 15-inch stroke. There are two speeds operating the screw, one quick and the other slow.

The hoisting is done by two pairs of engines which are worked in the same house with the canting engines. These are vertical engines having 12½-inch cylinders and 12-inch stroke. They are geared to a shaft 5 inches diameter and 50 feet long. On the outer end of the shaft is a large worm geared into a steel worm-wheel 6 feet in diameter, keyed to the end of a winding drum. This drum is 4 feet in diameter and 10 feet 6 inches long, chased for its whole length with a shallow spiral groove to receive the rope. The rope is of steel wire 6 inches in circumference, and consists of six strands each of thirty wires. The drum contains sufficient rope to lift the blocks to a height of 130 feet.

Briefly stated, this is the description of the apparatus, and from it a fair idea may be obtained of the working of this huge lifting appliance.

At the trial, a test load of 200 tons, consisting of a lot of iron rails, was lifted 10 feet clear of the wharf, and then the back leg

was travelled on its screw to its extreme length until the load reached 45 feet beyond the wharf. The whole of this work was performed silently and smoothly, the machinery working in the most satisfactory manner. Mr. Lyne expressed his entire approval of the way in which the work had been executed.

The cost of the shear-legs, engines, and iron work, including erection, was £9,670. The foundations also form a coucrete wharf 150 feet long. There is 30 feet of water in front. the wharf standing 10 feet above low water or 40 feet from the bottom. These foundations cost about £12,000, and the foundations of the back legs and engine house cost about £2,000, making the whole cost of the shear-legs, including wharf and foundations, £23,670. The Imperial Government require these shear-legs for repairing the large boilers of the men-of-war, for lifting the guns in and out, and for dealing with other heavy pieces connected with the vessels.

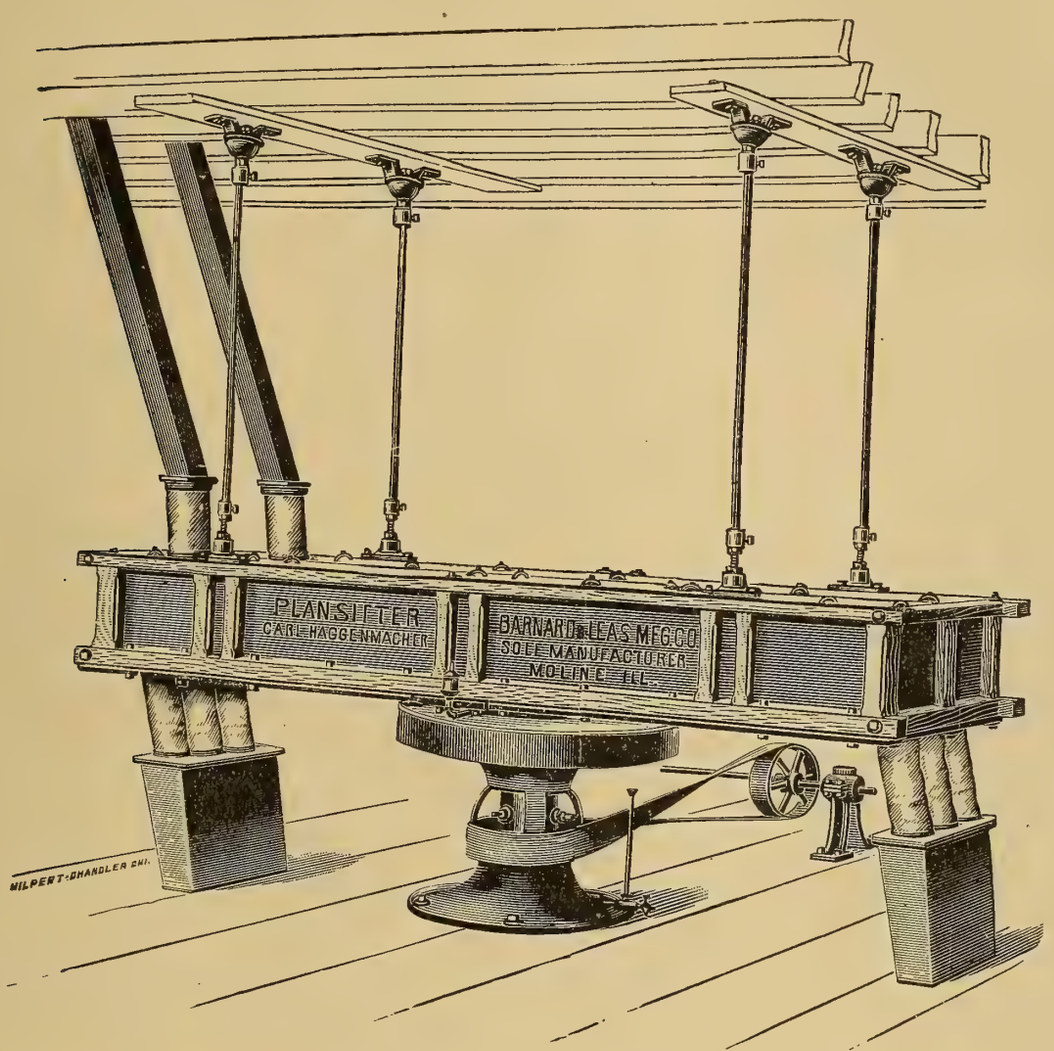
The Minister then paid a visit to the workshops. The machine shop contains a complete set of lathes, steam hammers, drilling machines, and other appliances for refitting or repairing any part of the machinery on board a man-of-war. The shop is 200 feet in length and 60 feet in width, and two travelling cranes extend the whole length of the shed. One of the travellers has 20 tons and the other 30 tons capacity. These cranes are driven by a pair of compound condensing engines placed in a separate compartment at one end of the shop. A building behind the machine shop, has a complete forge containing a number of smith's hearths.

The next building is a foundry where there is a complete set of appliances comprising a Roots' blower, and three sets of cupolas, and also furnaces for brass castings. The shops are provided with all the appliances required in a well provided and complete foundry.

The Minister also inspected the wood-work shop, where is erected a log and deal sawing frame, a circular saw, band saw, etc. He then visited the new torpedo store, where racks are provided for storing some 55 whitehead torpedos, and complete set of drawers for storing all the separate parts of these complicated instruments of destruction. Over this torpedo store is a work shop containing lathes for repairs necessary in connection with the torpedos. There are also on the island large dining barracks, boat sheds, and sail loft. There is in course of erection a very large commissariat victualing naval store cousisting of four floors. The Harbors and Rivers Department is constructing this building under the supervision of Mr. Darley. It occupies two and a half acres of floor space, and even this large

building is not considered more than is sufficient for storing the vast quantity of material that is to be kept for refitting the vessels now attached to the station. The contract for the building is £27,000, and it will probably be finished by the end of the year.

Sydney, August, 7th, 1893.



THE PLANSIFTER.

BARNARD & LEAS MFG. CO., MOLINE, ILL.

The drawing above, which from the name is, no doubt, of German or Austrian origin, shows a machine to bolt or sift flour, and is a remarkable departure from established practice of centuries past.

It is curious that in familiar processes universally practiced, there comes sometimes complete revolution. For ages people go on moving in a "rut," as it were, proceeding with confidence in long precedent, and it is in just such cases that a sweeping change is apt to come about. Two of the most remarkable in the last twenty

years have been in the processes for grinding and separating flour from wheat and other grain.

The abrasive grinding stone, that by attrition or masceration crushed and pulverized grain, is thousands of years old, not less than two thousand, and possibly three thousand years old, excluding its use in Egypt where some more thousands of years may be added. The mill stone has all this time remained the same with an "eye" or hole in the center where the corn was led in, and from there spread, crushed and escaped around the periphery. The action required was pressure, rubbing, rolling and scraping, in some indeterminate proportion that would clean off the bran and disintegrate the pulp.

If twenty-five years ago one had asked the most prominent mill engineers in the world respecting this process, the answer would have been: "These conditions, determined by ages of experience, have shown that a peculiar kind of stone, rubbing together with an increasing velocity as the material grows finer, is 'the only means of performing this operation. The mill stone is perfect.'" Now, at the present day, only twenty-five years later, these same engineers and millers admit that the correct way to produce flour from grain is to simply pass it between metal crushing rollers; only this and nothing more; the most simple of all methods; the same that is practiced in the case of other friable materials.

The revolution is complete, and within less than one age the mill stone with its thousands of years of precedent has passed out forever. What a comment on human knowledge and skill, and how strange that of all places this discovery should come from the most conservative of European countries, Bohemia and Hungary in Austria. Following this revolution comes another almost equally wide in portent, and possibly in fact, relating to the separation of the bran and flour.

For centuries past, and as old as our Saxon forefathers, the revolving reel or flour bolt has held its place with the mill stone. The action of this device, with the flour falling from the top to the bottom off the ribs, so as to drive the finer particles through the silken or gauze covering by impact, sliding, stirring and shaking was thought perfect. No one troubled themselves to think farther. The "bolting chest" was uniform the world over; supplemented now and then with centrifugal bran dusters, purifiers, scalpers and so on, but the bolting reel remained untouched, unquestioned and a completed process.

Now comes the "plansifter," shown in the drawing, which from inference we believe to be a simple "sieve" operating on the principle of a common hand sieve, the material rolling and sliding easily over the screen or bolting cloth without falling or concussion. Numerous certificates from those using these machines are sent by the makers, and the method seems to be making its way much faster than roller grinding did, because but little change is required to substitute this method for the bolting reels.

In a future article we expect to explain the mechanical construction of these machines, and must warn our milling readers that there is here another possible revolution. About 150 machines are now at work in this country, and most of them in the highest class mills, such as the Pillsbury and Washburne mills, at Minneapolis, Minn.

FLUID FUEL.*

BY ADMIRAL SELWYN.

About twenty-six years ago, in 1867, I took up the problem of oil burning at the point at which I found it, from the labors of Schapoosky, in Russia; Mr. Mallet, C. E., Messrs. Field and Ayden, C. E., and others in England; and Colonel Foote and several others in the United States, about 1865, of liquid or oil fuel as compared with coal. At that time the efforts of all the inventors on the subject, and there were many, were directed to burning the oil without too much smoke, and getting an evaporative duty up to once and a half, or at best twice, that of coal. Now as the calorific value or evaporative duty of coal is *theoretically* nearly sixteen pounds of water by one pound of coal when the coal is of the very best quality, and the *practical* duty is about one half of this, or eight pounds of water per pound of best coal, the whole being a sadly imperfect operation at best, resulting in the production of ashes, soot, smoke and slag, it seemed as if, should oil be burnt without anything of the kind, a large advance in the production of steam must be the result. From that time to the present I have made many experiments on the full scale on all kinds of land and marine boilers, and I am enabled this evening to give you an account of the results I have obtained and demonstrated for some years past.

*Read before the Technical Society of the Pacific Coast, Sept, 1, 1893. Reprinted by permission.

These results are so far in advance of everything that has been done elsewhere, either in Russia, England or the United States, that I hope engineers, whether by land or sea, will take deep note of

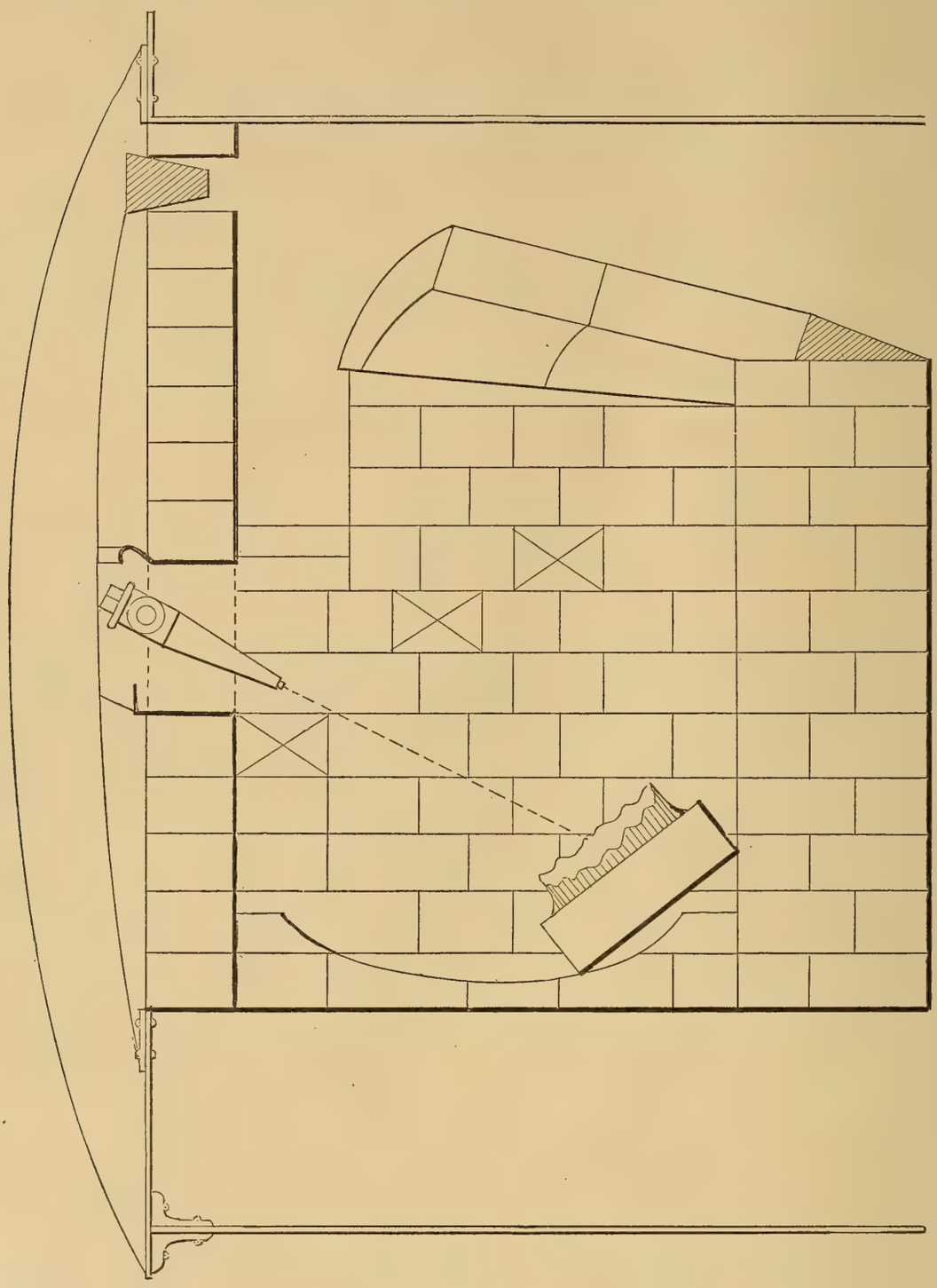


FIG. 1. SHAPE OF THE BRICK FURNACE FOR BURNING FLUID FUEL.

them, and the extremely simple methods by which they are obtained. To those engineers I need hardly say anything to remind them that of all engineering work the basis is fuel, and that therefore there does not exist an engineer in the world who has not an

interest in the discovery of a cheaper, or more easily managed, fuel, and when I say, that with the means at present easily available, we can have six times the evaporative duty of coal without any stoking or stokers, for no more weight carried, and little, if any more, cost per ton, they will, I am confident, think the subject an object of legitimate discussion in a technical society. On the blackboard I have given a rough sketch of the necessary appliances (for which there are now no existing patents) used by me for many years past. Any engineer can pull out his coal grate, and put the furnace in, in forty-eight hours at most, and it will not take him much longer to make the injector (atomizer), and fit the pipe and tanks. It can all

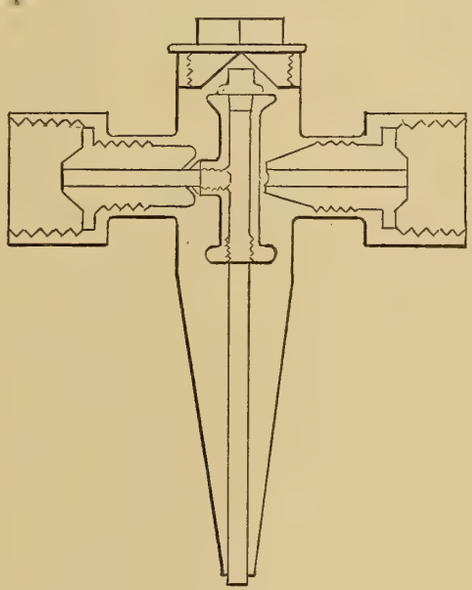


FIG. 2. THE INJECTOR OR ATOMIZER.

be pulled out, and the boiler be burning coal again if desired in twenty-four hours. But I do not believe anyone would ever wish to do it after he had once tested the result obtainable, and my experience is not a small one as it extends over more than a quarter of a century.

Having said this much you will perhaps permit me to go a little into the root of the matter, for no one can do anything thoroughly well unless he knows the reason why he does *that* rather than anything else. There is science in the swing of a shovel of coal, why should there not be in the use of a more perfect fuel? There are three kinds of fuel, solid fuel, as coal or wood ; liquid fuel, as oil or alcohol ; gaseous fuel, natural or artificial, but all must take a gaseous form before they can unite with the great supporter of combustion, the oxygen of the atmosphere. To effect this change work

must be done, and this work in the case of a solid fuel requires, according to the best authority, six units of heat (or pounds of water evaporable) out of the sixteen available. There then remain only ten units utilizable. If, as the same authorities are agreed in saying, two more units disappear in waste heat going into the stack to produce draft enough to supply the air, no more than eight units remain to give us evaporative duty, and less, if after all there is smoke and soot, denoting an imperfect combustion. It is not extraordinary then that only eight pounds of water can be evaporated by the use of one pound of the best steam coal in practice.

In any case where thick black smoke passes off, as much as fifty per cent. of the calorific effect is probably lost. We may now pass on to the consideration of liquid fuel. Here we have a substance consisting of carbon as before, but with a considerable proportion of hydrogen. Besides this it is on its way to become a gas, the atoms composing it are more widely separated already, and therefore not so much work disappears in effecting their union with oxygen, instead of six units, less than four units will be wanted. Owing also to the hydrogen present the theoretic calorific value will be twenty-one instead of sixteen, twenty-one less four leaves seventeen units for evaporative duty instead of ten, and 16.9 pounds of water were, in 1869, actually evaporated per pound of oil used in experiment with a boiler (of ordinary marine type at that time) of 160 nominal horse power, burning heavy oil of lubricating quality, and having a specific gravity greater than salt water. This I believe to be the highest duty of which *oil alone* is capable. The experiments lasted for nine months, were undertaken for the British Admiralty, and were under the close supervision of their own engineer the whole time.

I have all along insisted that oil of a less specific gravity than salt water must not be used on board ships whatever may be done on land. The ship's hold is practically a confined space, in which if any gas can be given off at a less temperature than 300° Fahrenheit it may form an explosive mixture with the air below deck, and blow up the ship. The heavy oil of which I speak will not give off gas at less than 360 Fahrenheit, and cannot be lighted, or burnt at all, unless it is atomized by air or steam, or else supplied with a wick. It is even less dangerous on this account than coal, which has often been known to take fire spontaneously when containing pyrites.

There is a most important difference between the blowing in of

oil by means of steam as compared with blowing in with air, which is not by any means generally understood. The steam contains hydrogen, and the air does not. One pound of steam (considered as water) is required to blow in one pound of heavy oil at common pressures, up to fifty or sixty pounds on the inch, less as that pressure is increased. This, by some persons, has been complained of as if it were a heavy tax on the boiler using oil. But as a fact, for which I can vouch, each pound of steam so used produces the full calorific effect due to its hydrogen, and adds to the duty of the oil fuel seven more units of heat, bringing the evaporation up to twenty-two or twenty-three pounds of water (measured from the supply tanks) per pound of oil and steam burnt. The hydrogen finding incandescent carbon in the furnace unites with it to form hydro-carbon, and is then burnt with the above useful effect. Roughly, in this manner, there can be obtained three times the evaporative duty of the best steam coal. Now the hydrogen being a gas is "fluid" but not "liquid" fuel. Being a gas the loss in dissociation is not more than one unit of heat, and it readily combines oxygen, as we know from the oxy-hydrogen blowpipe, to produce intense heat. We have therefore entered on the use of pure gaseous fuel derived from water, and automatically produced.

Why, as the French say, "should we stop on so good a road?" 214 times its own volume of air is being delivered into the furnace by the steam, which also blows in and converts the oil into spray. Four fifths of that air is hydrogen, the strongest known combustible. When in the form of nitrous acid it can be shown on the highest chemical authority to be capable in combination with six atoms of hydrogen of evolving 329,000 heat units.

At any rate I have long ago seen it burnt, and burnt it myself under ordinary marine and Cornish boilers with a result of measured evaporation from oil, hydrogen and nitrogen together, of no less than forty-eight pounds of water per pound of oil used, plus the above gaseous substances, which cost just nothing at all.

This is six times the power of evaporated, "or calorific value," of the best steam coal, and will enable future engineers to drive a steamship round the world, or a railway train across the continent, at full speed, with one supply of fuel weighing no more and occupying less space than a single supply of coal.

I am not yet prepared to give full information as to how the nitrogen is burnt, nor as to higher duty than six times coal, which is no doubt possible, but no changes are needed in the furnace, or the

injector shown, nor any other which cannot easily be carried out by a ship or railway engineer. All the figures I have given are taken from notes made during the actual working, and were checked by civil and naval engineers, to whom my work was always openly shown, is as far as I could be certain of the causes and effects. Of course I drew many inferences, which I am slow to bring forward till everything can be tested and proved to complete demonstration, knowing well how necessary such caution is before asserting a new truth or science, or indeed any departure from long established practice however absurd it may become in the light of later discoveries. As far back as 1869 I had not only heard of but carefully examined cases of high evaporation, but I could never find anyone who knew what cause to assign it to, till I actually saw in my own furnace the apple-green flame of burning nitrogen, as described by some of the older chemists (who knew well that it was a combustible of great power, though gun cotton and dynamite had not then been invented) and got forty-eight pounds of water evaporated per pound of oil used by the assistance of the hydrogen of the steam and the nitrogen of the air. These latter then, their nature and their effects have justified. I submit the new nomenclature, I have used "fluid" instead of liquid fuel, for while all liquids and all gases are fluid at our ordinary atmospheric pressure, the gases are not liquids, and such a compound fuel as I have been describing cannot properly be comprised under the term of liquid fuel.

Being fully impressed with the cardinal truth that a paper should only be "a peg to hang a discussion on," I will no longer detain those present from a discussion which I expect will be so profitable to the steam user, and therefore I hope to many among the engineers and technologists generally.

After the reading of the paper, Admiral Selwyn referred to a diagram on the blackboard, which illustrated the shape of his particular furnace, and the shape and arrangement of the injector or atomizer, shown on pages 670 and 671, which he explained to the Society in detail, laying particular stress upon them as the essentials in his method of combustion.

DISCUSSION.

MR. GEO. W. DICKIE.—"Mr. President, I would like to say a few words on this subject, because some of the statements made by the Admiral are rather astounding to me, especially in regard to the efficiency of liquid hydro-carbon fuel, such as the waste of petroleum.

I met in Chicago, Signor Soliani, of the Italian navy, who presented a paper to the Engineering Congress on this subject, and the result of a series of experiments that had been made on several vessels of the Italian navy. I may say that he is an enthusiast on the burning of liquid fuel, especially on war ships, for several reasons that do not apply in the merchant service. It can be carried on in places where coal could not be stowed, and has the advantage of easy transportation from one part of the vessel to the other.

Quoting from Signor Soliani's paper, he says:

'Experiments were made by Mr. Urguhart, at that time director of the Baku-Tiffis, and the Guazi-Tzaritzin railways, and by Messrs. Nobel Brothers, to ascertain the heating power of oil fuel. One kilogramme of oil fuel when burning, yields about 11,100 units of heat (metric system) against about 7,700 given by coal. The heating power of the oil fuel compared with that of coal ought therefore to be in the ratio $\frac{11100}{7700} = 1.44$ to 1.'

He also mentions experiments made in England under the supervision of Mr. Sennett, of the British navy. These I have examined myself pretty closely. He experimented both with steam and compressed air in the atomizing of the oil, and he thinks there is some advantage in the use of steam. The practical ratio as given by Mr. Sennett, of oil fuel compared with coal, was 1.6 to 1. This statement compared with the statement to-night by the Admiral, is rather astonishing, when he states that the evaporating power of liquid fuel is equal to 6 to 1."

ADMIRAL SELWYN.—"Pardon me, I said fluid fuel, not liquid fuel."

MR. DICKIE.—"In all discussion of fluid fuel we must take into account one fact, which acts very decidedly against its adoption; that is, the amount of this fluid that is available. On board ship we must have a fuel that will not ignite under 160° to 200° Centigrade. It would be dangerous to carry otherwise. The American product of this fuel is very small. Most of the residium or waste from petro-

leum is consumed in our refineries, and the percentage is very low. In the Caucasus the percentage is much higher, running all the way from 17 to 30 per cent. The total product of this fuel in Russia does not exceed a million tons a year. It has been very successful in the Caspian Sea and on the Volga because it is cheap there. It is sold at three francs per ton. The country nearest thereto, that would reap the greatest advantage from its use, would be Italy. But there the price is from 27 to 38 francs per ton, which makes it impractical, unless for some special purpose, as compared with coal.

The experiments that have lately been carried out have been very extended and thorough, and the fluid fuel has been credited with all the saving in labor, the saving of dirt and ashes, and similar advantages, and yet we have reluctantly come to the conclusion, after a series of experiments extending over two or three years, that as matters are at present, without a vast increase of the product, and without a cheapening of it in the maritime stations where it would be used, coal not only holds its own against it, but the percentage in favor of coal is very high indeed. In fact, from the statements made to me by Signor Soliani, the difference is as two to one.

I make these statements to-night because I am fresh from a lengthy discussion of this subject by some of the ablest men who have taken it in hand.

There is a vast amount of petroleum fuel used in this country in its crude state, but it would not be desirable on board ship. We have used it here in San Francisco Bay, and the results have been rather disastrous on account of the volatile nature of the fuel. Petroleum fuel is used for the production of steam at the Exposition, but the kind there used cannot be successfully applied at sea under the present methods of using it."

PROFESSOR H. B. GALE.—"I have been greatly interested in the paper before us. It states some results which are certainly very surprising. If they can be well substantiated, the author has made one of the greatest discoveries of the age.

I have followed very closely the published accounts of experiments made on fuel, particularly liquid fuels, and have witnessed some experiments with oil, but have never seen or heard of any results approaching anywhere near to those reported in this paper. I think if the author expects the world to accept such wonderful results as six times the evaporative duty of coal, as reliable, that he should give more details as to the methods of the particular experiments where he has obtained such results. I know from experience

that it is very easy in making tests of the evaporative qualities of fuel to be led into serious errors from side causes.

It has been known for some time that a certain heating effect is sometimes produced by the combination of nitrogen in the manner described. Some years ago I listened to a paper at the Academy of Science in St. Louis, on this subject. The result of the experiments then reported was that the amount of heat obtained from the nitrogen was extremely small, and practically of no account.

Now, if it is possible to increase the effect of this element to such an enormous extent by the use of the particular furnace and fuel described by Admiral Selwyn, it is certainly something worthy of very profound and careful investigation. But I must confess that the paper has failed to convince me that this is possible. The furnace does not differ very essentially from some other furnaces which have been used in a similar way for burning oil fuel, and no such effect has been produced. Twice the effect of coal has been considered about the maximum that could be obtained.

Again, if compounds of nitrogen were formed in appreciable quantity in the case described, we should expect they would have some effect upon the metal of the boiler; and if nitrogen were consumed to the extent claimed, we should have in the analysis of the gases the evidence of that, and the proportion of nitrogen which was burned. From the analysis given I did not see that there was any evidence of such action, but rather the contrary. It is possible that the author has the results of an analysis which shows the combustion of nitrogen, and the amount. If he has such it would be very interesting to know it. I am not sure whether the calorific effect of a pound of nitrogen burned in this way is known to chemists, but as we have some chemists here with us this evening, I should be pleased to hear from them on this point."

Mr. Wagoner.—"I have looked into this matter of fuels, both solid and liquid, several times, and I think the calorific values that are usually given may be accepted as correct. Beginning with green wood, whose value is about 4,000 heat units per pound; dry wood may be taken at 6,000; coal, such as comes to San Francisco, ranges from 10,000 to 14,000 units; coke, 12,000 to 14,000; tarry refuse oil from the refinery, 16,000; and crude oil, California, 18,000 units. These figures are the practical results of tests made under boilers by me at various times and places, and they are sufficiently near correct to enable the engineer to make a choice of fuel.

Concerning the remarkable results claimed in the paper read this evening, I do not think anyone well informed would admit the possibility of burning nitrogen in the manner claimed; therefore, whatever heating effect was obtained by the experimenter was that due to the formation of CO_2 and CO, and the analysis of waste gases showed such was the case.

One fallacy which is quite common, deserves mention, *i. e.*, the burning of water as fuel. The proponents forget that it takes as many heat units to dissociate steam as can be gained by the recombination of its elements, and with any other combination of said elements there would be a loss of heat."

MR. STUT.—"A few years ago I read a number of articles on this question. I think Prince Henry of Prussia instigated an investigation of the subject of liquid fuel, to ascertain the possible economy for the nation in the use of this fuel on torpedo boats. He noted what had been accomplished in England and other countries. If I remember correctly, the results of his investigations were about as Mr. Dickie stated, that the evaporative effect of liquid fuel, as used on the Black Sea, was about 11 to 12 pounds of water to a pound of oil; while the coal would be 7 or 8 pounds of water to a pound of coal. Unless the amount of this fuel is very large, and can be obtained at many different places on the globe, I do not see how much use can be made of it. Admiral Selwyn probably knows much more than I do as to the quantity that can be supplied.

I was employed by Mr. Dickie some years ago, and we made a little investigation and some tests of liquid fuel, and I know that we were not favorably impressed with it. I think we found it cheaper to burn coal. Is not that so, Mr. Dickie?"

MR. DICKIE.—"Yes, although the very high price of that fuel, delivered here, does not admit of its comparison with its use in other places where it would be cheaper. This fuel would have to be delivered at 75 cents per barrel to equal coal at $5.75 per ton."

PROFESSOR REULEAUX.—"I have learned from Russian engineers that the use of liquid fuel in Russia is about the same in expense as coal or wood; that in Moscow, for instance, it is fully as cheap to use oil, but that this is not the case in St. Petersburg.

I am afraid that Admiral Selwyn has not given us as complete an explanation as he may be able to give, as to the manner in which he arrives at such great results as the evaporation of forty-eight pounds of water from a pound of oil. Perhaps he will explain further, so that we may understand it better."

MR. W. G. CURTIS.—"In regard to the use of oil on the *Solano* and other ferry boats of the Bay, several years ago, I am not prepared to state the facts. We used a residual oil that cost $1.40 a barrel, and as near as I can remember, this price would about equal ordinary coal at $6.00 a ton. The matter, however, is not fresh in my mind."

ADMIRAL SELWYN.—"Mr. President, I think my answer must be a general one to the objections. First of all, gentlemen, I may say that if I had not had everyone of these objections before me for the last six and twenty years, I would not be here to talk to you to-day.

Secondly, there has been the most careful and skilled observation of every trial I have made by both civil and naval engineers. Everything was watched to see that there was no possibility of error in the measurements, the water was measured into the tanks, and out again to find what had evaporated, and thus the process was subjected to every test known to engineering. Therefore there is no doubt or question about what I am saying.

In the first place, as to the *supply* of fluid fuel, for that is really the most fatal objection, if it be not obtainable. I think you all know that the coast of South America has oil that is constantly running into the sea. My friends Treadwell and Noble have twenty mills there, and can send you just as much oil of any quality you choose to ask for.

Next, in speaking of our supplies, we have inexhaustible oil works. The shale of England is ten miles wide, and six hundred and fifty feet deep wherever we have gone to the bottom, extending across to Germany and Russia, and that will furnish more oil than we can use if the world lasts another thousand years.

I am not here to tell you of a new thing, but of a thing which I have studied, and in which I have been a leader for the last twenty years. The Germans, Italians, and Russians, have made inquiries about it from me, and came and studied in my boiler room at London. If they do not get the effects I have produced and vouch for, it is not my fault. If they will follow what I have given they will find that what I have said is borne out by the facts.

In regard to the use of oil on the San Francisco ferry boats, some were successful experiments, and others were not so. Considering that these experiments were made in the same locality, did one set of engineers do wrong and the others do right? We must presume so. Fifty-five per cent. economy was worth considering,

though this is very little, and much less than I got when I started my work in 1867. There are gentlemen who have come to me and examined my work, and have gone away again and tried to imitate it without asking me about it; they were not willing to be instructed, and their labors stopped there.

I think you will find that in Germany they have followed the old ways in using this fuel. In Russia they are burning it against all the laws of combustion, in a boiler surrounded with water. I am in communication with a gentleman there, who keeps me informed of the methods employed; they are still very far behind in it. But if they get twelve pounds of water evaporated from one pound of oil, the subject is worthy of discussion."

MR. VON GELDERN.—"It is unfortunate that the author is unprepared to fortify the statements he has made, with data obtained from direct experiments. As long as we are left without actual figures, we cannot be expected to consider a subject for which such extraordinary results are claimed. An enthusiastic author must be prepared to submit more than generalities, if he would expect a detailed discussion of the subject he has chosen to present before a technical society.

In the present state of the fluid fuel question, our worthy guest has not been without his co-laborers, and all data heretofore available have not led to the sanguine conclusions drawn by him this evening."

Engineering, London, in commenting on American beam engines and the wooden steeple frames employed in this country, says a clearance of five inches has to be provided in the cylinders to make up for the wobbling of the wooden frames. Such a statement in a secular newspaper would be ridiculous, in a technical journal it is imbecile. The wood is in compression only, and the clearance required in the cylinders is not governed by this matter at all. Beam engines for steamers are about to pass out, of this there is no doubt, but it is not owing to wooden frames or other features of construction, but a result of high pressure and compounding or multiplying steam cylinders; also because screws are becoming better understood and more widely employed. *Engineering* publishes drawings of a beam engine made recently by Messrs. Inglis, of Glasgow, with two cylinders set diagonally and hitched at the same point to the end of the beam. The framing is steel-plate work, and the whole seemingly a complete design.

SINGLE-ACTING ENGINES.

Willans & Robinson, makers of single-acting steam engines in England, claim to furnish engines to operate with 13 pounds of steam per indicated horse power per hour, when condensing, and 18 pounds per hour non-condensing, and as they have made some thousands of these engines, and have over 40,000 horse power connected to dynamos, it is hardly worth while to dispute the economy of their methods. This is not all. The oil consumed is one fifth as much as with common engines, and one fifteenth as much as with high speed double-acting engines.

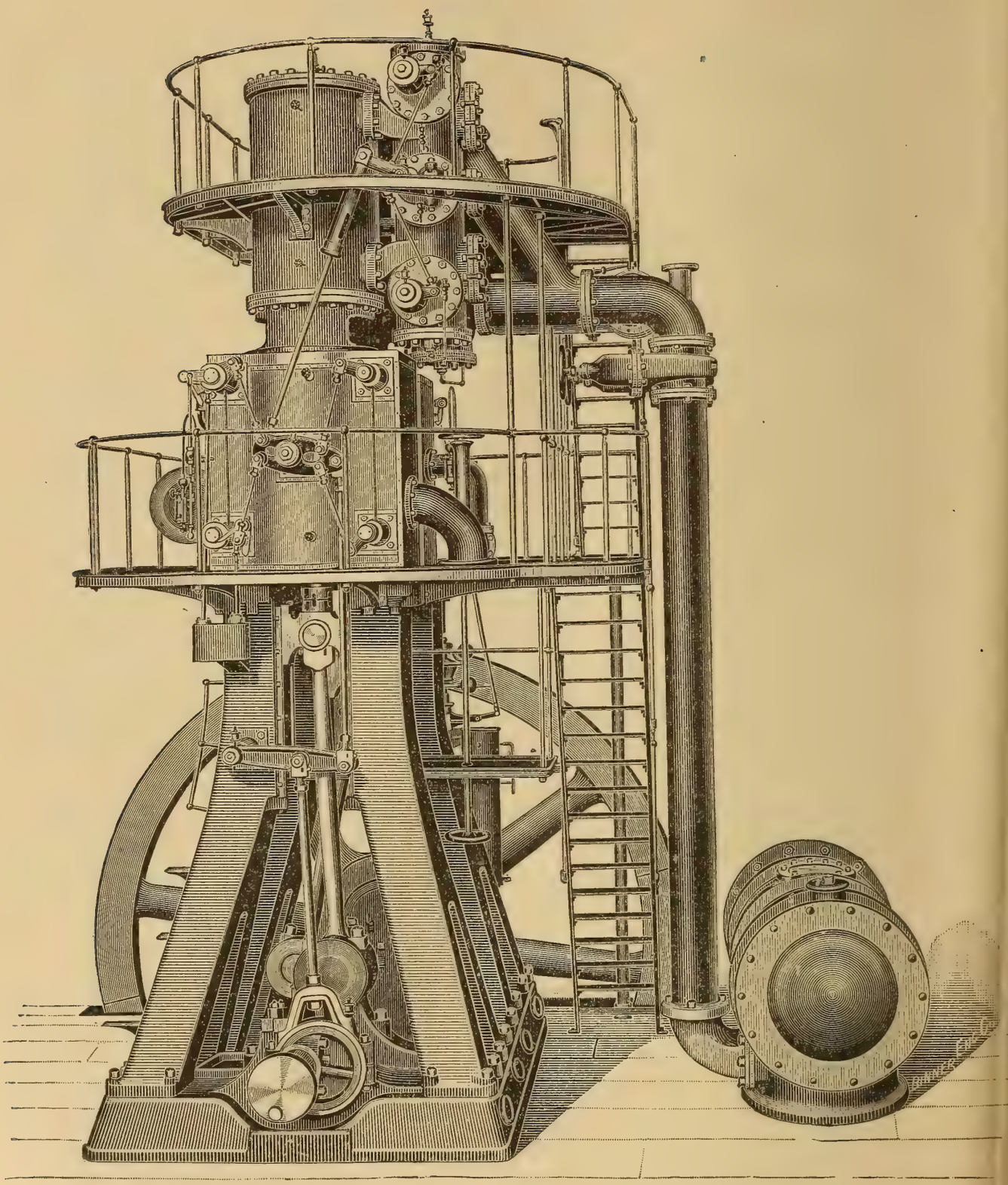
It is twenty years ago since Thomas Willans began making single-acting engines, and he followed it continuously, down to his death, within a year past. The engines are triple expanding, and have the distributing valve in the center or axis of the pistons. This we believe is in advance of any single-acting engine practice elsewhere, and the wonder is that similar construction is not followed by others.

The single-acting engine is not done with yet, and we are waiting the fulfillment of some prophecy made ten years ago respecting this class of engines, and believe now that with good design and workmanship, such as is put on high speed double-acting engines, the single-acting type will excel for dynamo driving, if all things are considered.

The art is new, and the Westinghouse Company at Pittsburgh have been almost alone in their efforts to bring out the single-acting engines in this country, and while their efforts have been hampered in every way, the business has been made into an enormous and successful one, against all kinds of opposition.

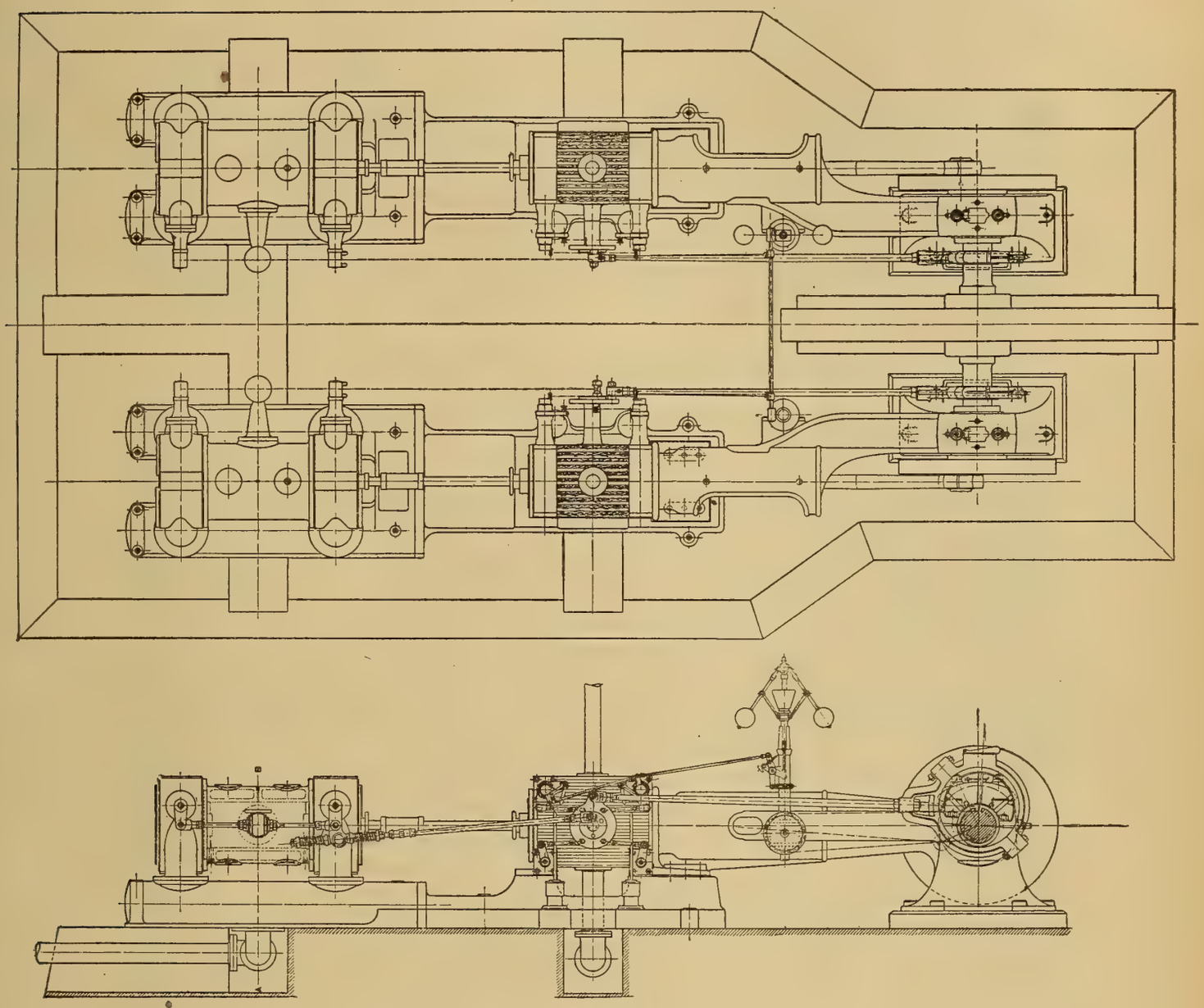
The Willans engines above mentioned, are triple expanding, the cylinders superimposed, forming a kind of pyramid tapering upward in a very symmetrical form. They gave very good results in a steamer that made trips from England to Bombay, some years ago, but we have not heard of them since these first trials, and conclude there was some impediment to their use, for marine purposes, discovered in this experiment.

FIG. 1.



RIEDLER SYSTEM OF AIR COMPRESSORS.—FRASER & CHALMERS, CHICAGO.

FIG. 2.



THE RIEDLER SYSTEM OF AIR COMPRESSORS.

FRASER & CHALMERS, CHICAGO.

In our last issue we devoted some space to the Riedler system of pumping water, and mentioned the application of the same methods to compressing air or, as may be said, to pumping air, because the Professor's improvements in such apparatus relate broadly to impelling fluids of all kinds, and the mode of operation is practically the same, with, however, special adaptation to elastic fluids. As we have a good many times during five years past called attention to these methods, and the experiments of Professor Riedler that have

led up to his system, so this branch of the subject need not be repeated here.

In order to arrive at present practice in this country, we applied to Messrs. Fraser & Chalmers, of Chicago, who are the licensees under the Riedler patents, for information respecting the pneumatic machinery made by their firm, and have received from them a full explanation, which we herewith lay before our readers.

With other things sent is the following explanation of the "Riedler system" as applied to air compressing, which is much clearer and more complete than anything we can write on the subject.

RIEDLER SYSTEM OF AIR COMPRESSORS.

"The Riedler system of air compressors has been used in Europe for a long time, although it has not so far been introduced into the United States. In Europe the first experiments were made by Professor Riedler as early as 1883 with large Bessemer blowing engines, and since 1885 with large air compressors, resulting in the present improved type of compressor. The system at once met with very great favor, and has been introduced with signal success for air compressing plants both in mines and in cities.

In Paris four large Riedler compressors with triple-expansion engines of two thousand horse power each, are used for a system of pneumatic power distribution, and have, according to official tests, proved to be very economical, requiring 60 per cent. less fuel than the other compressors in the Paris central station, owned by the same parties and working under similar conditions. With the Riedler compressors in Paris the total cost of work has been reduced at the rate of 2½ to 1 as compared with the ordinary system of compressors formerly used at the Paris central plant.

The economy of the Riedler system, important as it may be, is not its only recommendation. Simplicity and small size for given capacity are two very prominent features of the system, and both of these are attained by the aid of the positive controlled valves used for these compressors.

In the ordinary compressor the suction and discharge valves are allowed to operate automatically by the pressure of the air, and are liable to irregularity. Such self-acting valves admit of only a very small lift, thus throttling the passages. Riedler valves operate with a liberal lift, avoiding any throttling, as these valves are not left to operate by themselves, but are controlled by a positive valve motion. Ordinary valves often involve breakages and rapid wear and tear, as well as a disagreeable noise. These defects necessitate running the common compressor with self-acting valves at very slow speed, so as to reduce the shock of the valves to a minimum, and they require great expense of repairs, and even then cannot be worked economically.

In the Riedler system all this danger and annoyance is avoided by operating the valves through a positive valve motion instead of

automatically. This valve gear avoids any irregularity in the action of compressor valves. It allows full and liberal lift, and thus diminishes the number of valves and valve seats, and lessens the liability of leakage.

The Riedler valves are allowed to open freely by the action of the air, while the closing is done by positive valve gear. The valve chamber, as a rule, contains only one suction and one discharge valve The valve spindle, passing through the chamber, closes the valves at the moment when the stroke of the piston changes. Near the end of the stroke a very small lift is allowed to the valve, which can be regulated at will, thus affording a relief for the valve under high speeds and variable pressures.

In high-speed compressors springs are inserted either in the closing gear or on the valves, so that by compression of the springs the action of the valves is modified to meet increased resistance and variable conditions of working. The ordinary resistance the valves meet is so slight that it will not compress the springs.

The movement to operate the gear may be taken from any part of the motor, for instance from a wrist plate, as in the case of a Corliss engine ; all that is required is that the valve shall receive a rocking motion similar to the reciprocating motion of a slide valve. Large compressor valves are provided with cushions which allow them to open freely, but which prevent them from opening beyond a desirable limit. This insures the valves remaining fully open during suction or discharge until they are closed by the action of the valve gear described. It is just this free opening, together with the positive closing, which makes it permissible to run this engine at a much higher speed than is practicable with common air compressors having self-acting valves.

The introduction of a special gear for operating the valves, instead of leading to complication actually simplifies the compressor. It is on account of the very limited lift of the ordinary valves that it is necessary to have quite a number of them, both suction and discharge, which require constant attention and renewal, causing stoppages of the machinery. In the Riedler compressor there is no limit to the lift of the valve, consequently they can be built with only one suction and one discharge valve for each double-acting compressor, thus vastly simplifying the inside arrangement and the working parts of the compressor, and what little valve motion there is, is upon the outside, rendering them easily accessible for adjustment and attention.

The valve motion can be derived from the same eccentric which operates the steam valve, either directly or through a wrist plate. The arrangement of the gear in special cases may be widely modified, but it always accomplishes the same purpose, controlling the suction and discharge valves mechanically. The compressor proper, as here described, can be made of any style that may be deemed advisable, either single or compound, or even triple cylinder. In most cases the air is not used at so high a pressure as to require

compression in three stages. The horizontal style of compressor, driven by compound-condensing Corliss engines and with compound air cylinders, will generally be found the most economical and convenient, although the vertical style of engine has some advantages over the horizontal, notably in space, and because the weight of the piston does not cause the cylinder to wear on one side."

In addition to this matter, engravings have been sent of both the horizontal and vertical types of air compressors as made by the firm, shown in Figures 1 and 2 herewith, also special descriptive matter relating to both machines as follows:

VERTICAL TYPE. FIG. 1.

"The plate, Fig. 1, shows a compound Riedler air compressor, with a compound condensing Corliss engine, all of the vertical type, constructed for the City and Surburban Gold Mining Co., Ltd., of South Africa.

The vertical type is employed where the nature of the ground makes it difficult to secure durable foundations of the length required for the horizontal compressor, and where ground space is limited or of high value.

The vertical air compressors have bed plates and framing of great strength and solidity, and a large carefully-fitted crank shaft and cross-head bearings, so the highest desirable speed can be attained without vibration or heating.

The air cylinders are supported upon the steam cylinders, so connected that stuffing boxes are easy of access. The machinery, as a whole, is heavily built, but the moving parts are of the very best material to secure the greatest possible lightness, and all are counterweighted.

The engine cylinders are steam jacketed, and working upon the compound system obtain a much higher efficiency than is possible with simple twin compressors, the pressures and stresses upon the two sides being closely equalized and reduced to a much lower maximum than with uncompounded compressors.

The air usually opens into the engine room, but provision is made for connecting a suction pipe for drawing in cooler air from the outside. The delivery of the low-pressure air cylinder is to a receiver conveniently placed, and having a large capacity and surface for cooling by water, so reducing the work upon the high-pressure cylinder. Both cylinders are water jacketed.

The compressor is arranged with Riedler's mechanically-geared valves, which permit the straightest passages and require the least maximum velocity of air, the dimensions being ample to avoid increase of heat or pressure by throttling. The valves are placed in special cylindrical valve chambers, convenient of access on one side of the air cylinders, but in other constructions they are placed at the ends of the cylinders.

The valves close by mechanism, but open automatically by air pressure. This is more efficient than mechanical opening, because mechanism opens the valves slowly by eccentric movement while the piston is at its highest speed, not giving a sufficiently quick and free discharge, and as it is impracticable to adjust mechanism to the changing conditions of temperature of air and cooling water, and pressures in suction and delivery, which determine the most favorable point of opening, a loss of work by useless compression results from mechanical opening. This is avoided, and by a special construction of the valves in two parts obtain a quick opening with a light variation of pressure, and also effect a quick closure by mechanism.

The two valve parts may be called the main valve and loose ring. The main valve is moved by positive mechanism, and guides the ring, which is very thin, and movable by air pressure when the main valve is withdrawn by the mechanism. The ring opens freely at the required air pressure, having a play in the main valve, which is closed by gear in a manner so graduated as to agree with the decreasing piston speed as to secure uniform air velocity, giving high efficiency and a gentle closure.

One delivery valve is placed in the upper and one in the lower part, while both suction valves are placed in the middle part of the valve chamber, all being connected together, and operated in the same manner by rods from the wrist plates of the Corliss engine.

The governor is sensitive, regulating speed of engine under varying air pressures, and enabling the engineer to regulate the number of revolutions to the conditions of pressure and air consumption, so as to maintain a constant air pressure under a varying consumption of air. If such a thing should happen as the sudden breakage of the supply pipe the engine would stop.

The arrangement of galleries and stairways, and the accessibility of all parts of the machinery which require attention show that the designer has had careful regard for convenience in operating the plant, as well as for the essential considerations of economy of power, high duty, and a uniform and reliable service."

HORIZONTAL TYPE. FIG. 2.

"Referring next to Fig. 2, which shows in true elevation and plan the horizontal arrangement of the Riedler air compressors. The drawing is taken from a standard machine furnished to the Horn Silver Mining Company, of Utah. These may be employed as gas compressors or blowing engines. The peculiar merits of the Riedler system apply in the highest degree to the horizontal air compressors. Avoiding much duplication of statement we confine this description chiefly to the arrangement of the horizontal type.

Compressor cylinders are often connected with the steam cylinders by two rods liable to spring and yield, a cheaper construction than that which we employ, but liable to cause trouble and limit the speed of running. The compressor cylinder is mounted on

a substantial bed plate going through to the frame of the engine, enabling to the fullest extent the advantages of high speed peculiar to the Riedler system.

Not only are the air cylinders provided with water jackets, but we avoid all trouble of heating at the stuffing boxes by also surrounding them with large water jackets.

One suction and one delivery valve is placed on either side in the cylinder heads, and are easily accessible for any attention they may require. Clearance is reduced to a smaller percentage than with other systems, and occasions no loss of efficiency.

The bed plate is employed as an air receiver, a neat and economical arrangement, the main pipes and connections being accessibly placed.

A careful design of parts for the proper distribution of all stresses ensures great durability in the machinery. All shafts have large and well-fitted bearings. Piston rods are large, and wearing surfaces at the stuffing boxes are unusually large to avoid wear upon the cylinders and pistons.

Special valve details are used where gases are to be pumped which tend to destroy ordinary seats. The Riedler system, with its large valve spaces and high lifts to the valves, is better adapted than any other for this class of service.

Indicator cards give practical proof of the theoretical advantages of the system, showing a higher percentage of useful work than obtainable with other types of air compressors. The usual arrangement of compressors, compounding cylinders, realizes the highest economy, and it is only for small sizes, or for blowing engines under special conditions of service that twin or single, simple air cylinders are recommended."

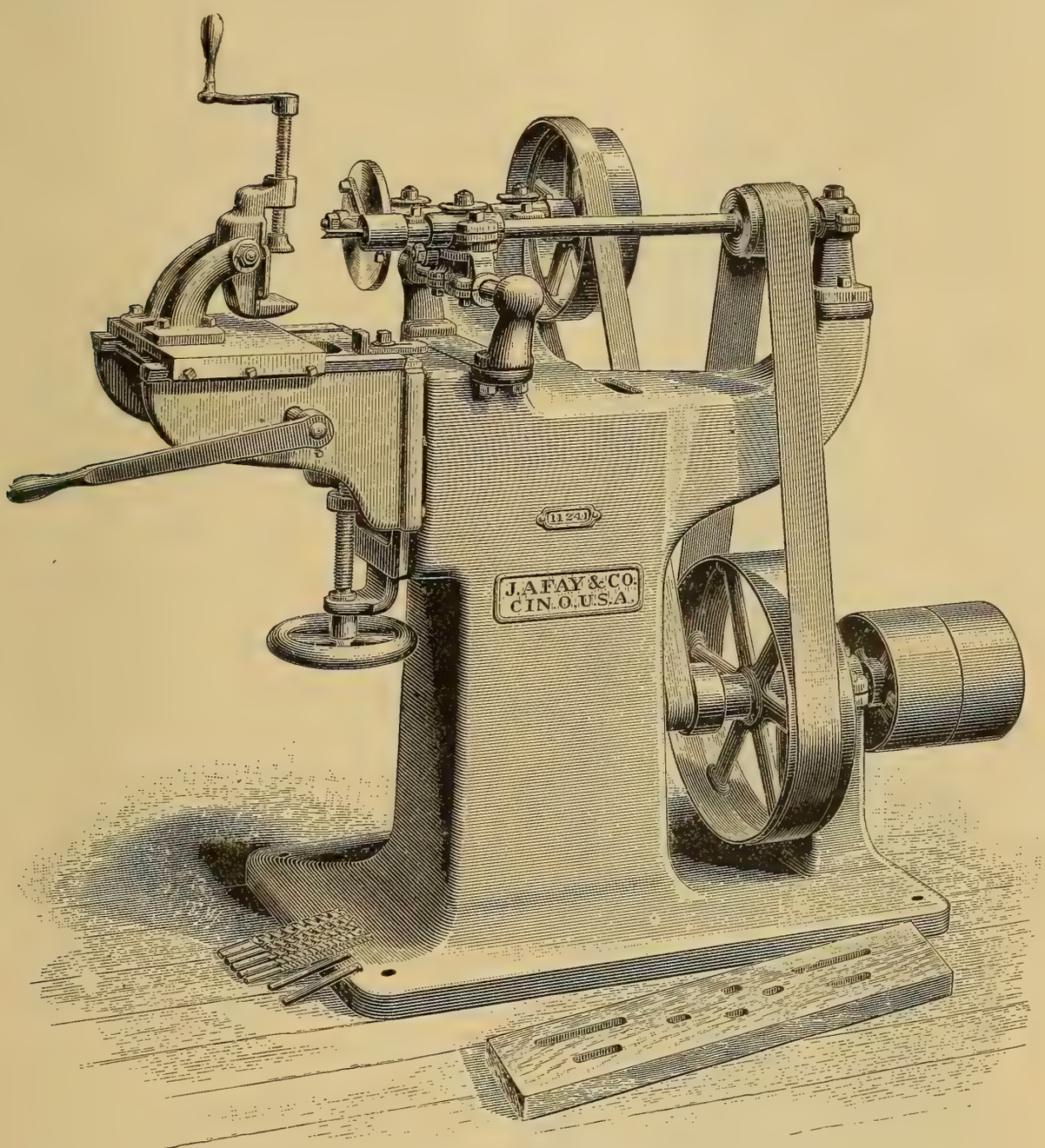
ROTARY MORTISING MACHINE.

THE J. A. FAY & EGAN CO., CINCINNATI, O.

The drawing opposite shows what may be called the complete "evolution" of a very useful machine, not very widely known. It is commonly called a chair-mortising machine; because at first invented for making oblong mortises for chair slats, and is yet employed mainly for that purpose, but is also adapted for various other purposes. It is really a routing machine, consisting of a rotary bit driven at high speed, and given at the same time a vibratory motion equal to the length of the mortises. This vibratory or reciprocating movement can be in a true plane to produce straight mortises, or in an arc to make curved mortises, as is required.

In the present machine the line of reciprocating motion is regulated by a curved bar, seen below the front spindle-bearing on which this bearing slides. This curved bar can be turned, and adjusted in bearings at the ends, so the machine will cut a straight

mortise, or one curved either upward or downward as is required. The rotary motion is generally at a rate of 6,000 to 7,000 revolutions per minute, and the reciprocating motions one tenth as many. At these speeds the mortises are cut out almost instantly, smooth clear of chips, but with round ends, which is preferable for chairs.



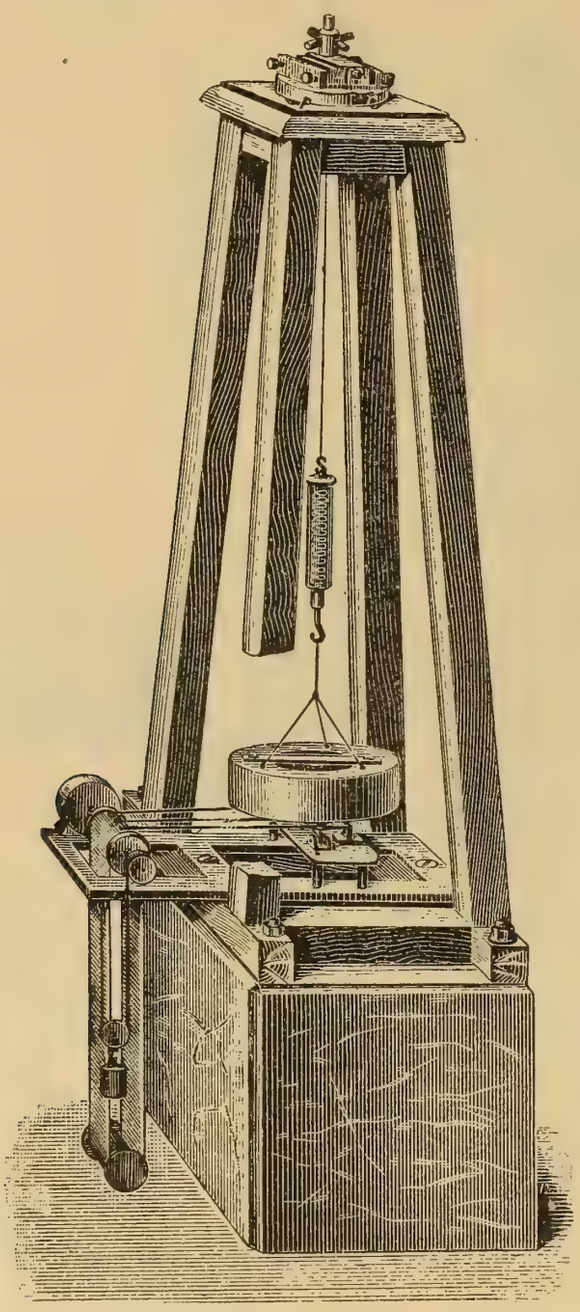
ROTARY MORTISING MACHINE.—THE J. A. FAY & EGAN CO., CINCINNATI.

The machine, so far as we know, is a Cincinnati one, first invented there about forty-five years ago. It has passed through the usual amount of modification, beginning with a rectangular pine wood frame, and has now ended in the design above, which seems to leave nothing more to be done.

THE SEISMOGRAPH.

THE A. LIETZ COMPANY, SAN FRANCISCO.

People in California, who are periodically shaken up, become accustomed to the name above in reports of earthquakes, but not many are aware of what this long cabalistic term implies.



The A. Lietz Instrument Co., of this City, send the accompanying drawing of a "seismograph," of which the following is a description, such as we can give.

The action of these instruments arises from the inertia of a suspended mass; that remains still when the earth shakes, or oscillates, slides about, so to speak, beneath this suspended mass, the movements being traced by a point or pencil attached thereto. This will be easily understood, in so far as horizontal movement, by referring to the drawing, where a large circular weight is suspended on a slim wire, with means at the top for adjustment up or down, so the point seen beneath will just touch a card that receives the diagram of motion, if diagram it can be called. Most of our readers will have seen the extraordinary vermicular scratches that Professor Geo. Davidson sometimes furnishes for publication, looking like the signature of a palsied person, written in the dark, but showing precisely the motions of the earth during a "shake." These diagrams are the horizontal component, but as every one knows, there is often a vertical movement as well, and frequently this is the greatest. The seismograph also takes note of and records the vertical com-

ponent in the following manner: Inertia is the same in all directions, and to permit the earth to move in a vertical direction, independent of the suspended mass, it will be seen that there is near the middle of the suspending wire a sensitive coil spring, which yields at a touch, so that if the earth with all other parts of the instrument, rises or falls, the weight remains still because of its inertia, the coiled spring yielding the same as if the weight or mass was floating in the air, so the relative vertical movements of the earth and the weight are recorded by proper mechanism at the side, which we will not attempt to explain.

If seismatic movement was slow the instrument would not record correctly; but such movements are not slow, quite the reverse in fact, as every one knows.

We do not know the extent of the trade in these instruments, which are made by the A. Lietz Co., but it is no doubt a good deal, because any well-equipped house in California should have a thermometer, a very flexible barometer, a well-mounted anemometer, and a seismograph. These instruments will all find regular employment on this Coast, and the four if properly observed will occupy time that otherwise might be less usefully spent.

SMOKE ORDINANCES.

The Legislature of Massachusetts has been at the trouble to enact a smoke law that will most likely end in smoke, or rather in fees and disappointment. The act provides that steam furnaces must burn 75 per cent. of their smoke, but of course cannot give any idea of how this proportion is to be ascertained. It is almost impossible for a legislature, or for the "law" even, to distinguish between definite and determinable quantities aud those which "no feller can find out." We have several times pointed out that a tangible law can be made to regulate the amount of fuel burned to the square foot of grate surface, and that such a law could be enforced, but all ordinances and acts that deal with "smoke" end in smoke. It is a thing that cannot be weighed or measured, consequently its nature and quantity is a matter of opinion. A Pittsburgh lawyer, who removed to Philadelphia, was called upon to prosecute a smith who used bituminous coal in that cleanly city. "Why," said he, "that man, if he lived in Pittsburg, would be prosecuted for not making enough smoke."

TECHNICAL SOCIETY OF THE PACIFIC COAST.

This association met on the 1st of September, President Grunsky presiding. One new name was proposed for membership.

As honorary guest of the evening, Geheimrat Professor Reuleaux, of Berlin, one of the eminent mechanical engineers of the day, was welcomed by the President and asked upon the platform. He responded to the invitation and expressed his appreciation.

Admiral Selwyn delivered an address before the Society on the "Existing State of the Fuid Fuel Question," which was discussed at length by Professor Reuleaux, Messrs. Dickie, Gale, Stut, Wagoner, and others.

Mr. R. J. Rolfson exhibited and explained an improved friction dynamometer, connected with an automatic computing device, whereby the horse power of a prime motor is read off directly without any calculation. A discussion of this subject was held over for a subsequent meeting.

The following resolution was read and accepted:

IN MEMORIAM.

P. J. Flynn was born in Tralee, County Kerry, Ireland, in the year 1838. His early education was that ordinarily received, and purely rudimentary. He soon, however, developed a fondness for mathematics, and his inclinations in the choice of a vocation were towards the engineering profession. His surroundings and the locality in which he lived afforded little encouragement to his ambition. His resolve as to his vocation in life was soon formed, however, and at the age of fifteen he passed in a competitive examination at Addiscombe College, England, for a position in the Public Works Department of the Indian Service.

Arriving in India, Flynn was sent to the Roorkee Engineering College, where he spent six months in preparation for special work in Indian engineering. His rise as an engineer in the Indian service was rapid. Ten years service found him an executive engineer in the Public Works Department of the Punjaub. After remaining in India about eleven years he came to the United States and settled in San Francisco. Here Mr. Flynn remained for some time practicing his profession, when, thinking that the southern portion of California offered a better opportunity for the practice of hydraulic engineering, he removed to Los Angeles, where he established his permanent residence, devoting his entire time, until the day of his death, to his profession, and literary work connected therewith.

Mr. Flynn died at Los Angeles, California, on June 1st, 1893. He left surviving him a brother, John Flynn, residing at Sligo, Ireland, and a sister, Ellen Flynn O'Neil, residing at Brooklyn, New York. The deceased was the author of several works and pamphlets on engineering subjects. At the time of his death he was a member of the Technical Society of the Pacific Coast, of the Institute of Engineers of England, of the American Society of Civil Engineers, and of the American Society of Irrigation Engineers.

An instance of the unbounded esteem and regard in which his brother members of the profession held him was exemplified to a marked degree by the character of the reception accorded to his recent work, published in San Francisco, entitled "Irrigation Canals and other Irrigation Works."

No one had a greater love for his profession, or more keenly felt and appreciated its responsibilities, or was more sensitive or alive to its duties than P. J. Flynn. As a man he was generous, manly, fair minded, fearless, conscientious, honest, and of sterling integrity, and always in search of the truth. As an engineer he was capable, painstaking, studious, and thoroughly wrapped up in the science of engineering. Although often solicited to lend his name to doubtful schemes, never did he yield to temptation, and the indorsement of an irrigation project by Mr. Flynn meant that it was both feasible and honest.

His profession was his love, and he did not follow it for the mere sordid desire of gathering worldly treasure, but his life was dedicated to it as a devotee of science, always inspired with the high-minded ambition to direct the forces of nature for the benefit and advantage of man.

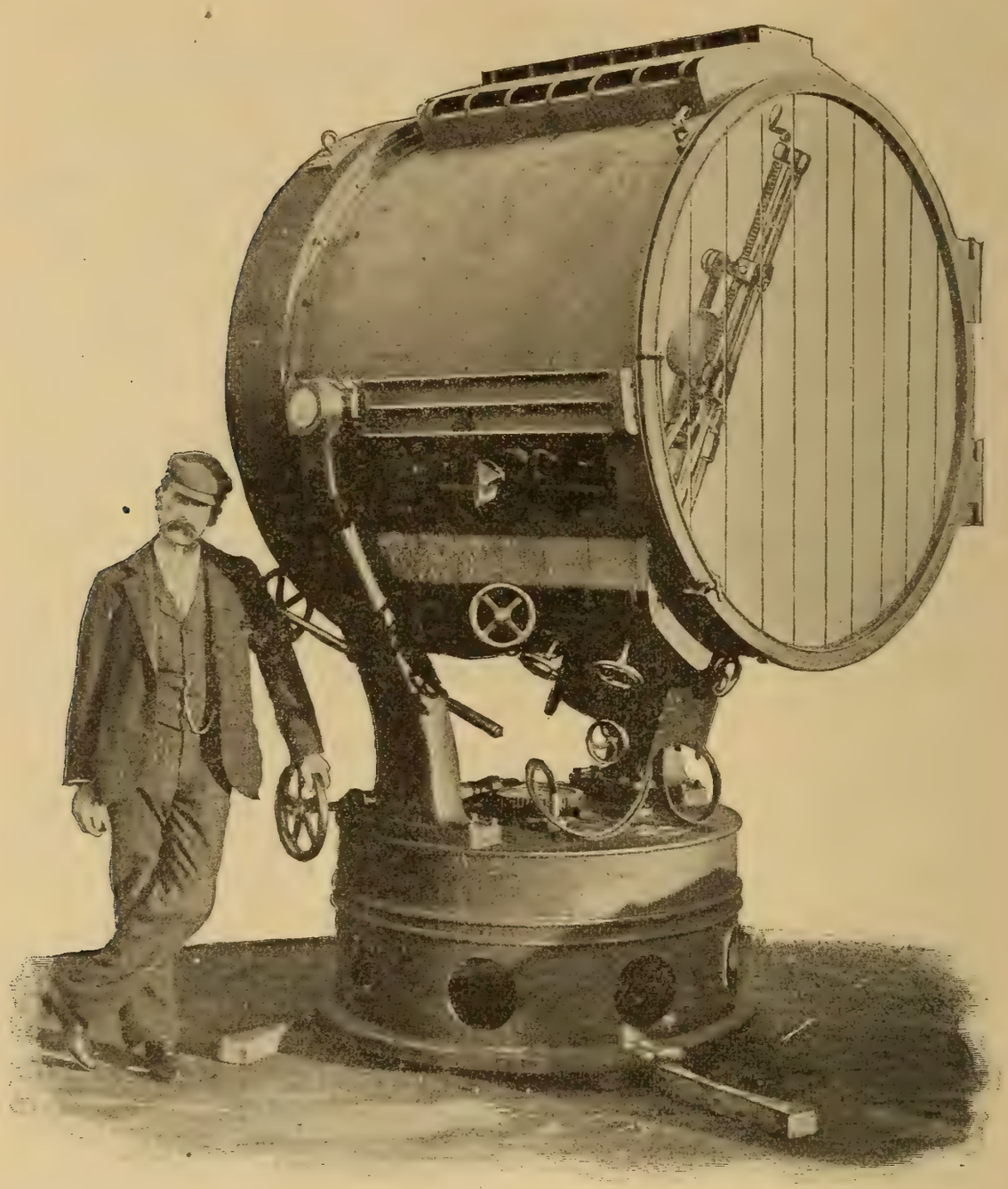
His genius for work, his good judgment and the result of his labors have merited him the praise of the engineering profession.

Expressive of our sympathy and our respect for him, and our regard for his work, therefore:

Be it Resolved, that in the death of P. J. Flynn, the Society has sustained the loss of an honorable and distinguished member; the profession the irreparable loss of an able and industrious engineer; and the community a man whose attainments, sterling probity, patient industry, high talents, generous nature and amiable disposition endeared him to all appreciative of these qualities.

Resolved, that in this hour of bereavement we tender our deepest sympathy to the brother and sister of the deceased, and in token of respect and condolence we direct that a copy of this Memorial and these Resolutions, be transmitted to his surviving brother and sister, and that a copy thereof be spread on the minutes.

FRED. EATON,
BURR BASSELL,
V. J. ROWAN,
Committee.



ELECTRICITY.

AN ENORMOUS SEARCH LIGHT.

The General Electric Company, have recently constructed what is no doubt the largest electric search light or reflector that has ever been made. They send the following interesting description of the light and particulars of its construction :

"It stands about 10 ft. 6 in. high to the upper side of the ventilator on the top of the drum, and the total weight is about 6,000 lbs, but so perfectly is it mounted and balanced that a child can

move it in any direction. It was built by the General Electric Company.

The reflecting lense mirror used in this projector is 150 centimeters or 60 inches in diameter. It is a concave spherical mirror of the Mangin type, free from spherical aberration, reflecting a sensibly parallel beam of light. It was manufactured especially for this projector in Paris, France, and is a most perfect specimen of optical work, three and one-fourth inches thick at the edges and one-sixteenth of an inch thick at the centre, and weighs about 800 lbs. The metal ring in which it is mounted weighs about 750 lbs, and the total lens, ring and cover weigh about 1,600 lbs.

This great mirror is mounted at one end of the big drum, the outer end of which is furnished with a door consisting of a metal rim in which are fixed a number of plate glass strips five-sixteenths of an inch thick by six inches wide. Inside this drum, and sliding upon ways arranged on the bottom, is placed the electric lamp, the source of the light, which is reflected by the mirror. It is entirely automatic in its action, is six feet high and weighs about 400 lbs. The carbons used are also made especially for it. The upper or positive carbon is one and one-half inches in diameter and twenty-two and one-half inches long, with a five-sixteenth of an inch core of soft carbon running from end to end through its centre. The lower or negative carbon is one and one-fourth inches in diameter, is fifteen inches long and also has a core of soft carbon running through its centre. In addition its outer surface is heavily coated with copper. The positive carbon is set a little in front of the negative and thus almost all the intense light of the incandescent crater is cast upon the reflector.

The maximum current at which this lamp operates is 200 amperes, and at this current the lamp has a luminous intensity of about 90,000 to 100,000 candles, the reflected beam a total luminous intensity of about 375,000,000 candles, an intensity which the eye cannot appreciate. In looking at the side of the beam the spectator only distinguishes a stream of light of comparatively low intensity, but in looking at the beam directly its brilliancy is fully seen and the effect is absolutely blinding. Ventilators at the top and sides allow a constant current of air to pass through the drum and dissipate the heat generated by the arc lamp, and they are so arranged that no light can escape through them.

All the connections for adjusting the positions of the carbons and the lamp are brought through the drum to the outside, and are arranged in close proximity to one another at one side so that all may be manipulated by the operator without moving from his position. Through openings in the drum covered by densely colored glass the operation of the lamp may be watched, and its adjustments verified.

The drum is supported by trunnions in bearings at the top of a Y-shaped fork, set in a base plate, and the whole is supported on a system of friction wheels, forming a turntable resting upon the top

of a massive pedestal supporting the whole structure. The drum fork and base plate may be rotated horizontally on the turntable either by hand or by gearing provided for this purpose. The drum may also be elevated or depressed in a vertical plane by similar gearing.

Before the projector was sent to the World's Fair a public test was made at Middletown, Conn. From the roof of the works the great white beam of light shot forth into the obscurity of the night, and slowly swept the countryside for miles around, bringing every object upon which it was directed into brilliant and distinct relief. It illuminated the roofs of distant villages and scared their inhabitants, and lighted up the sign boards miles away so that they could easily be read by means of a glass. The projector was turned upward towards the sky, and the beam, like a super-natural divine finger, wrote words upon the clouds.

It was observed that the space within the beam was violently agitated, and closer observation revealed the fact that millions of moths and minute insects were hovering in it, attracted by the brilliancy of the light. Next morning a great quantity of dead moths, beetles, other insects, and some small birds, were swept up from the roof on which the projector stood.

How far the powerful beam of light of this instrument can be seen is difficult to state. The search light set up by the General Electric Company on Mt. Washington, in the White Mountains, has a diameter of only thirty inches, and a reflected light from the mirror of about 100,000 candle power, yet the newspaper can be read in its beam ten miles away, and the light can be seen from points 100 miles away. How much farther then could this 375,000,000 candle power light be seen in a clear atmosphere free from moisture, if the projector could be mounted upon an eminence sufficiently high to clear all surrounding obstacles?"

NOTES.

The difficulty of regulating the speed of water wheels attached directly to electric generators, especially in the case of pressure turbine wheels, such as are employed under moderate heads, does not seem to be receiving successful attention. At Ottawa, Canada, men are kept on duty to regulate the speed of water wheels by hand, watching a voltmeter indicating the variations of current on the lines employed to operate street railways. The difficulty seems to be that where 1,000 pounds of force is required to operate a circular gate, or the chutes of a water wheel, 100 pounds is provided. The

aggregate of power required is not much, but when it is to act it must do so suddenly, and in a degree far beyond any apparatus such as is now provided. For a wheel of 100 horse power the regulating apparatus should be able to exert one ton at a rate of one foot per second. This might not be required except in emergencies, but there would be no loss in its maintenance. The slow and weak regulating apparatus, commonly met with, is wholly unsuited for water wheels driving dynamos.

The *Electrical Review*, London, was prosecuted some time ago for denouncing electro-medical quackery, and gained the suit without any difficulty by calling in unquestioned testimony that the whole system of modern treatment by means of belts and other "static" appliances is a fraud. These makers of electric belts have a space among the exhibits at the World's Fair in Chicago, which is little to the credit of the management, especially if such things are classed with and a part of the electrical exhibits. It is singular and discouraging that after numerous exposures of the fallacy of such things the public will go on buying them. It has been shown, over and over again, that currents cannot be generated in a "belt," and if they were there would be no effect whatever on the body.

Some recent experience in riding on electrically-propelled street cars brought to notice the great advantage of this system where the lines extend beyond the thickly-built districts, as at Stockton, Cal., or indeed anywhere, for nearly all lines go out into the fringes of a city. The point in question is the increased speed this system admits of, or, to state it another way, the control of speed. Taking the Stockton lines as an example, the rate in the main streets is not more than four or five miles an hour, while in the suburbs the rate is fully ten miles an hour. This is an important advantage of the electrical system compared with either horse or cable traction. The height of the cars from the ground is an inconvenience, but necessary to admit the motors and their gearing beneath the main floors.

MINING.

NOTES.

The California Miner's Association have issued notice of their annual meeting to be held in this City at Pioneer Hall, on the ninth day of October. This will be an important meeting in many respects, because of the recent application of the new law pertaining to hydraulic mining, and also because of an impending or even present activity in the gold-mining interests of this State. Among the subjects to be considered is a pending measure in Congress, called the Stewart Bill, that is thought to be an undesirable one. There will also be some action taken respecting the "rulings" of the Interior Department that affect mining matters adversely. Respecting this latter, "rulings" are all right in the hands of honest competent men, they are better than the law when to be trusted, but the only safety when there are hundreds, or even thousands, in position to "rule," is to stick to the statute, good or bad.

Our readers will remember, in 1892, the advent here of some Chinese agents or representatives of a wonderful gold ledge in China, sixty-five miles long and some fraction of a mile wide, that demanded about a million dollars' worth of machinery to exploit it. The question now is, what has become of this wonderful mine; also what becomes of many more cases of the same kind, large and small in character, that come with the months and weeks of each year? One of the principal cares of business people at this day is to avoid rogues who promote these hollow schemes, and for whom there seems no way of providing proper punishment. The boast of modern civilization is a victory over natural forces, and in supplying more completely various human wants, but there is no moral advancement. It is the other way.

The Johnston concentrating machine, made by the Risdon Iron Works, in this City, is a departure in a good many respects from common practice. The water and pulp instead of falling on the belt or apron from fixed tanks, and scattering about, escapes close to the surface from tanks moving laterally with the belt, and both

the sand and water are deposited in narrow ridges, so to speak, parallel to the traversing or feed movement. The difference between this and the sand and water falling some distance and scattering over the surface, seemes to produce a very different result in selection, and much increase the capacity for a given area of belt or apron. The movement of the apron and its frame is a compound of oscillation and reciprocation that corresponds very nearly to that given to a batea in operating by hand. So far as mechanical construction, all the required conditions seem to be well filled by these machines. This separation of metallic sand would seem to be an easy process, but the history of concentration proves the contrary.

There is a scheme, and a company to erect on the South Yuba River in Nevada County, California, a hydraulic and electric station to generate power to be transmitted to Grass Valley, Nevada City, and to various mines that lie within easy reach. The wonder is that this has not been done long ago. The physical circumstances are most favorable. The South Yuba River affords with an available fall, 6,000 horse power within three miles of Nevada City. Mr. Tredigo, a well known mining man, is president of the Water Power Company. Although electric transmission is new, we doubt if there are many places so favorable as this one that are left to be exploited. Some of the mines in the circuit are now well supplied with water power, the Idaho for example, but most of them are operated by steam power.

The contract system, which when introduced caused the great strike in the Broken Hill mines in Australia, has resulted in a wonderful change for the better in so far as reducing the cost of mining ore, and at the same time increasing the earnings of the men. The result is so remarkable that one can hardly credit the statements made up in the last report for July of this year for six months preceding. The amount of ore produced was 22,064 tons more than for the same period in 1892, and the working force was 600 men less, showing unmistakably the unreasonable character of the system that existed before the strike, and the unwarranted claims of the strikers. The "proprietory" have put aside a reserve of $400,000 to meet future contingencies, and the state of the property seems to be thoroughly prosperous notwithstanding the low price of silver. The ore taken out this year averaged $23 per ton, which may seem

a high yield, but it must be remembered that these mines are in an expensive country, and in an expensive part of it. Think of hauling water 60 miles, which has been done to supply for private use at Broken Hill.

If the African mines continue to turn out diamonds, like silver, this precious stone will fall in price. We much doubt if diamonds would be worth much more than good glass, if they were as easy to make or procure. The Kimberly mines may be an accident in Nature, are so, no doubt, but when $100,000,000 worth are turned out by the company in one year, there is certainly a chance of a fall in the price. The De Beers Company cover with their works and claims 36 square miles, and have worked to 1,000 feet deep in the "cones" where diamonds are found. It is curious that man's ingenuity has not been sufficient to produce crystallized carbon or diamonds. It may be done some time, and then our miners will be supplied with carbon-pointed picks.

Foreign exchanges report a new quartz mill to be erected in South Africa to reduce 1,000 tons a day, which, unless the ore is free and soft, will require 300 to 400 stamps if that method of crushing is employed. This shows a tolerably large mill, but does not equal one in Dakota. Captain Josiah Thomas, manager of the Dolcoath tin mines, in Cornwall, England, who came out here recently to examine the Temescal tin mines, in San Bernardino County, has been lecturing the Cornish people on the subject of California stamps for crushing ore. The mills of the Dolcoath Company, have, it seems, been fitted up with four batteries of ten stamps each; on the California system, which perform about twice the work of the average Cornish stamps, comparing on the basis of power consumed, also with equal gain in respect to repairs and maintenance. Some of the hearers questioned the merits of the stamps, and claimed they were an old invention, but Captain Thomas silenced them by saying he had seen one mine in Dakota where there were 700 stamps that crushed more ore than was raised in Cornwall altogether, and this plant was soon to be increased to a capacity of 4,000 tons daily. These stamps, we need hardly say, were not crushing tin ore.

COMMENTS.

Private advices from Philadelphia, the most stable of all among our manufacturing cities, leads us to think that we are much better off here in San Francisco than we imagine, that is, comparatively. The most affluent among the old manufacturing firms there have to pay their men in checks, and these cannot be cashed. Some works run five hours a day, and some less, and this in a city where manufactures are the leading industry, and where failure is less frequent than in any other large city in this country. No banks here have refused to pay their checks, at least none but one, and that an institution conducted on exceptional methods that should long ago have caused distrust. Failures are few, and there is a forbearance and community of feeling among the various industrial interests here, such as Philadelphia has always been noted for. Some one has discovered that "world's exhibitions" always bring about financial panics, and certainly chronology points that way.

The great iron ore trust, formed or announced on the first of last month, is not likely to result in much injury to any interest if the duty is taken off iron ore, as it certainly will be. There is a great difference between the consumers of petroleum and the consumers of iron ore, and the parallel between the ore trust and the oil trust does not hold. In one case powerful interests are affected, capable of a war if provoked, too strong to be withstood; but in the case of coal oil there are only consumers and merchants to deal with. The first are indifferent if they do not favor the trust, the latter are powerless to do anything but submit. The iron men are different, and the scope of the ore trust's power will be to maintain fair prices, and attain economy by combination. It is a colossal scheme with thirty millions of dollars for capital, but thirty millions will not go far when compared with the general iron interest of the country that will be affected by an attempt to force prices for iron ore.

Two steamers brought recently to this port 66,926 boxes of tin plates worth $400,000, on which our people pay in cash about $100,000 for duty, brokerage, etc. This is a direct tax on the food industry, where nine tenths of this tin is consumed. Such a tax at

this time when fruit is rotting on the ground, because it does not pay to gather and pack it, and when there are millions of people who would gladly purchase the fruit at its natural value, is an example of managing business by statute. This $100,000 is part of the fee paid for maintaining tin-plate manufacture at the East, and to enable importers two years ago to realize millions in profit by a change in the price of tin plates. A national revenue derived from imports of this kind is unjust in every way, on tin especially, because it is consumed mainly for "packages," which are usually favored in every way, and in most countries are returned free on railways.

The San Francisco wool dealers, and the other wool dealers, so far as heard from, have passed resolutions protesting against a removal of the present duty on wool, which is consistent. The situation now suits them precisely. They want wool to be cheap, and are astute enough to know that the present tariff is the cause of this cheapness. The wool dealers, or those who do business under that head, are really money lenders, who make advances on wool, and their profits are from interest on money. The more the wool grower is pressed by low prices the more money he has to borrow, and the more he will pay for it, so that cheap wool instead of dear wool is what is desired by these patriotic gentlemen who "resolve" for a high tariff on wool. Middle men flourish under low prices in all trades where advances are made on unsold products.

On all sides, and from everyone, there seems to be a settled opinion that prices are governed by "demand and supply," which is certainly not true. The fluctuations of prices are so governed. This is obvious, but the real price of anything, to which its exchange price always tends, is the cost of producing, or the amount of effort thus spent. Any price that sinks below the cost of production is no price at all, it is obliteration. A commodity furnished at such a rate ceases to be produced, and has no price in the true sense of that term. The instability of prices comes mainly from legislative interference and the accidents of production. The failure of crops from natural cause may increase the price of grain for the time. The supply is less than the demand, but not permanently. Everyone knows the normal or natural price will return, and cannot be materially changed except throughout long periods.

In 1880 the city of Brooklyn, N. Y., adopted a new charter centralizing the administrative power in the mayor in a much greater degree than is common in this country. The result was so beneficial that the "Brooklyn system" became a well-known term, and many other cities proceeded to adopt similar features in their charters. The main secret of success proved to be that Brooklyn had one or two good managers, and then came the abuse of power, a political boss, Mr. McLaughlin, and a "mess" of the worst kind, so the Brooklyn system, from being a model to follow, is now a thing to avoid. From this, and many other things, all things indeed of a political kind, one must infer that good government comes from centralized power in honest hands. Diffusion of political power offers a kind of safety, but what kind? A safety from absolute robbery, and no more. There seems no safety from corruption in city government where the political "machine" can be set up.

Madam Adam, the gifted French essayist, has written for American reading an article on the "French Complications in Asia, and the Threatened French Conquest of Siam." The argument is, the English take these distant countries, we are as good as the English, consequently have the same rights of conquests. It is a woman's idea and a woman's argument, notwithstanding the high attainments of the writer. She compares the present French aggressions in Siam to the British conquest of Burmah, forgetting that Burmah was a distracted country under a despot, and that the English had overwhelming interests in Burmah, which the French have not in Siam, and even in the latter-named country there are thousands of British residents, and that 95 per cent. of the import and 85 per cent. of the export trade is British. The French, with all their wonderful claims in modern civilization and attainments, are not a colonizing and governing nation, as their operations on this continent will show. England has shown a wonderful forbearance in this Siam matter, but there is a limit, and the limit might be an end of French power in Asia.

We traveled across Texas in 1888 in company with the President of the National Wool Growers Association, whose name we cannot now recall, and had the distinction of being set down in his notes as a lunatic for suggesting that a higher duty on wool would lower its price to the American producers. The matter comes to mind now, because of the fact that wool has never been sold in this country at

so low a price as now and for six months past. It is like the "hop trade." Seven or eight years ago hops rose to four or five times the normal price, and some of the growers here in California made fortunes, but compensation came soon after. The brewers, who are the largest consumers, set about some way to make beer without hops, and succeeded so far that they have not needed any since. So the wool manufacturers by one shift or another, principally by means of "shoddy," succeeded in doing without so much wool, and continue to the present time.

The *Ohio Valley Manufacturer*, after recounting the fact that $31,000,000 worth of iron and iron products were imported in eleven months ending in May last, and 25 per cent. more than was received in a corresponding period of the preceding year, remarks:

"What we need from abroad we must buy, but as in one State of this Union there is more iron than in all Europe, and since we have all the material and all the mechanical appliances and skill necessary to its manufacture, why do we spend so much abroad when we have all the opportunities to spend it at home? Thirty-one millions of dollars cannot be spared every year without starting a drain on the national pocket book."

This is true logic, and if the circumstances of producing iron were the same here as in the countries imported from, the iron would have gone the other way. The manufacturers or producers in this country are called upon to pay from 25 to 45 per cent. more for nearly everything consumed by them in their business, also expect to realize a larger profit than their competitors abroad. Labor may cost more here in some kinds of work, but costs less in other kinds; the difference is not great, at least is not more than permits the workmen to pay the greater cost of what they themselves consume.

ENGINEERING NOTES.

The Pelton Water Wheel Company, of this City, has recently prepared an extensive water power plant for the Moodie Gold Mining Company, of the South African Republic, to be erected near Barberton on the Queen's River. There are a number of mines situated around the station, within a distance of four miles, and the power will be distributed by electrical wires, dynamos and motors. There will be four wheels of 125 horse power, each under a head of 142 feet.

The wheels are 72 inches diameter, to run at a speed of 150 revolutions per minute, and are connected by means of rope gearing to the generators. The whole plant is of exceeding simplicity and cheapness, although durable and efficient in the highest degree.

The various devices for locking nuts that have been invented and patented in the last forty years would require a book to describe, and now when the whole subject has been exhausted, as one might imagine, some one, who is not a genius at all, comes forward and proposes an oblong piece of metal tapped through one end and screwed on outside the nuts, so the long end overhangs, and its gravity tends to screw it up if there is working or slackness. If the piece does not come in the right position, so the overhang tends to screw up, it is turned around and screwed on with the other side out. This costs nearly nothing, can be put on or taken off in an instant, and seems to have settled the whole problem in so far as horizontal screw bolts. Railways in Canada and in England have begun using these fastenings, and so far as tried with complete success.

The Railway Master Mechanics Association appointed, some time ago, a committee on compound locomotives, and in reports called out from various lines having compound engines in use, the saving in fuel varied from 8 to 45 per cent., which is equivalent to saying the reports are not reliable and of no use. One member of the committee claimed there was no more expense for repairing a compound than a simple engine, which is nonsense by any arithmetical rule we know of. Another section of the report says compound engines are suitable for variable service, which is a contradiction of plain inference at least, and, as the *Railway Review* points out, is contrary to the opinion of Mr. von Borries, who is an authority if there be one, on compound locomotives. We think the Master Mechanics had better appoint a new committee and proceed on some lines that will secure more accurate statistics.

In Columbus, Ohio, they pave the streets with brick. That is, they cover the streets with brick, but the streets are not made as they commonly are here in San Francisco, of a covering with no street beneath. The bricks are selected hard ones, laid on a substructure of rubble eight inches thick, or concrete and rubble six

inches thick, and are said to give good service. In Philadelphia and Baltimore the sidewalks, except in the business and best portions of the cities, are paved with brick, which is fortunate for the shoe trade at least. Soles are worn off in a week or two that would last as many months in San Francisco. Brick has many qualities desirable in a street covering. It is not too hard like granite, and offers a good "hold" for draught horses. Being very absorbent there is a tendency to dampness, and consequent avoidance of dust.

High-pressure steam has developed an unexpected difficulty in maintaining steam pipes. It seems anomalous that when boiler shells of as many feet in diameter as the steam pipes are in inches can be made safe, the pipes cannot. The difficulty is in movement of the latter. Being flexible all relative movement between the boilers and engines fall on the pipes. Expansion and contraction also interfere with now and then a "slug" of water driven through like an ordnance projectile. Mr. Ferranti ingeniously divided his great steam pipes at Deptford, London, into sections or sets of four or more, so as to provide flexibility and secure safety, and it is strange this method is not followed on the great steamers. The Italian engineers have reinforced the steam pipes in the navy by winding them with wire of delta metal. Copper is the common and best material for large pipes, and if riveted, instead of brazed, should be safe when made with proper proportions.

Mr. Philip Hichborn, the recently appointed Chief Constructor of the U. S. Navy, strongly favors the covering of war vessels with wood, and copper sheathing them. The problem thus to be dealt with is the principal one in maintaining a modern navy. A vessel is hardly in commission before she is ready for the dock, and the element of power of which we hear so much has but little bearing on the performance of a ship that has been a month or two in the water. Copper, this far, is the only metal discovered that will resist marine growths on a ship's bottom, and the problem is narrowed down to the best manner of covering ships with this material. Considering the amount of skill and effort expended in searching after preventatives, the field is not a hopeful one for inventors, and no doubt Constructor Hichborn's views are as advanced as any can be at this time.

LOCAL NOTES.

In the present issue we give a manufacturer's view of the financial situation, by Mr. Andrew Carnegie, in the *North American Review*. In our next issue will appear the views of an eminent engineer and scientific man, who goes farther and deeper into the causes that have set up the present unfortunate circumstances in the commercial affairs of this and other countries. It is about time something was understood of these matters, or rather that they were reduced to some mathematical form, which must be done in the end. Without absolute quantities there is no knowledge of anything — only opinions.

The recent abolishment of the special Sewer Commission, appointed last year to prepare a comprehensive plan for the sewers of San Francisco, is a portentious movement. This commission, composed of five of the most able men in the City, was soon cut down to two, and these retained in service by pressure of public opinion down to the present time. No one believes or pretends that the elected service in this City is competent to deal with the subject of a comprehensive system of sewerage, but it is a question of "politics," and competent engineers are never politicians. The necessary exposure of incompetent and dishonest work, which was unavoidable, has brought down the wrath of those who have benefitted by this misuse of funds, and after a fair measure of strength public opinion must give way to personal interests. What is to be done with the work accomplished is a question. There will, no doubt. soon again be a new uprising on this sewer problem, a new election, and the farce of reform repeated, but it is doubtful if ever again can be found a board such as was selected last year that would agree to serve in such a capacity. The Sewer Commission has dealt with, or attempted to deal with, 200 miles of sewers, that have cost six millions of dollars; are without system, and almost without record. A fund of $35,000 was set apart last year for this work, and $17,000 of the amount was turned back into the treasury. This, perhaps, is the main offense of Messrs. Manson and Grunsky.

The present and past talk of a railway between San Francisco and Denver, Col., is what may be called commercial nonsense. We have quite enough railways going there now, and a new one would

only increase rates so as to help maintain the rest. What we need is two railways to the feeding centers in the great California Valleys. There is business enough for a new line in the Sacramento Valley, and two new lines in the San Joaquin Valley. They are cheap to make outside of legal squabbling and terminal manœuvres. The mountain roads are continually set up as a defense or excuse for the high rates charged for transportation in the valleys, and how more mountain connections are to do any good is not made clear. The money required for such a line as the Denver one can be better spent.

The Union Gas Engine Company, of this City, have been quite successful in what may be called their auxiliary engines, for sailing vessels, and have lately fitted out a schooner, the *Bessie K.*, 93 ft. long, 26 ft. beam, with a 40 horse power quadruple-cylinder gas engine. The rate at which the vessel can be driven by the engine alone is not known. The trials made were against wind and stream at the rate of six knots or so, and the result is all that the owners desire. Petroleum engines make an ideal auxiliary power. There is no consumption of fuel, or expense when the engines are not in use, and they can be started at once without "raising steam." In the present case the company have employed horizontal cylinders on a low frame that lies flat on the deck, an arrangement that has a good deal to recommend it in the case of large engines, and when room is available. The *Bessie K.* has sailed on her first trip, and will return to this port in a short time, when a more complete report of her performance can be made.

A jute mill to cost half a million dollars is being constructed at Orizaba, Mexico, by an English company. The water of a stream called the Barrio Nuevo is to be employed for driving the machinery. The power, of which there is a great surplus, will be generated by Pelton Water Wheels, and transmitted 1¼ miles by electric wires. The fall is 115 feet, giving out, as reported, 11,000 horse power. Four generating dynamos are to be employed, and in the factory each machine will have an independent motor attached. We do not see why jute manufacture is not more extensively carried on here on this Coast. At Folsom, for example, where there is water power to drive mills. The consumption of jute bags on the Pacific Coast is enormous, and we will, no doubt, soon be receiving them from Mexico.

LITERATURE.

The Science of Mechanics.

BY DR. ERNST MACH.

The Open Court Publishing Company, of Chicago, have acquired the copyright and reproduced an edition in English of the above-named work, translated by Mr. T. J. McCormack. Its nature is indicated in the first paragraph of the preface, as follows:

"The present volume is not a treatise upon the application of the principles of mechanics. Its aim is to clear up ideas, expose the real significance of the matter, and get rid of metaphysical obscurities. The little mathematics it contains is merely secondary to this purpose."

It is an unique work, showing great originality on the part of its learned author, and judged on the basis of elucidation, has superior claims over most recent books of the class in the fact of being attractive. The author by his frequent historical allusions showing the evolution, to so call it, of the principles of statics and dynamics, beginning with Archimedes, 212 B. C., Da Vinci, Stevinus, and others of the 14th to the 17th century, indicates a research and labor fully compensated by the fact before mentioned, of rendering the work attractive.

The modern utilitarian view that truths once demonstrated should live only in formulæ, is defensible on philosophical grounds, if we leave out the fact that the main object of technical books is instruction, but that admitted, the skill of an author must be measured by the effects produced by his writings and how extensively they are read, and on these grounds Dr. Mach can certainly claim a foremost place, the present work having passed into a second edition in German, and will no doubt meet with an extended sale here.

The publishers have provided the furtherance of a remarkably well printed book, illustrated by two hundred and fifty plates and diagrams, all drawn and executed in the best of style. It will form a valuable addition to the library of students, teachers, engineers, and scientific men of all professions.

It is sold by the Open Court Publishing Company, Chicago, or through the trade generally. Price $2.50.

Universal Bimetallism.

Mr. R. P. Rothwell, the able editor of the *Engineering and Mining Journal*, has collated his writings and addresses on the subject of universal bimetallism with an international monetary clearing house, and published the whole in book form.

As many of our readers as have followed the literature of the silver problem, and that we imagine means nearly all, will be aware that Mr. Rothwell proposed, very early in the discussion of this subject, an international monetary clearing house to deal with the relations and values of gold and silver in such manner as to produce uniformity among the principal commercial nations, to distribute as far as possible the precious metal, and settle questions that have arisen and may arise in this vexed problem.

This is a business and common-sense view of the matter that must in the end prevail, because so long as coin can be transported between Europe and America for one per cent., how are we to maintain a proportion between gold and silver that differs more than this from European values? Any standard fixed here that varies two per cent. only from what exists in Europe will, under the operations of the "Gresham Law," drive either gold or silver out of the country, as the price of either is higher or lower.

If, for example, we assume a proportion of 16 to 1, and some other country 17 to 1, then silver would be worth about six per cent. more here than abroad, and it would be shipped as certainly as any commodity follows the line of demand. If the conditions are reversed, and we assume 17 to 1 against 16 to 1 in Europe, no one can imagine a better business than making about six per cent. by exporting silver.

It is useless at this day to think of anything but an international agreement, and

this is precisely what Mr. Rothwell proposes, and what must be done in the end, no matter what other expedient is tried. His proposition of an international bureau or clearing house reminds one of the story of Columbus showing his friends how to make an egg stand on its end. The cogency of the scheme appears when one asks for an alternative. If not this, what else?

Aside from the arguments presented in the work, and which it is impossible to consider here, the facts and statistics contained are especially valuable at this time, when people are groping about for some solution of the unfortunate financial circumstances of the present day.

The book can be procured from the Scientific Publishing Company, 27 Park Place, New York. Price 75 cents.

A Manual of Modern Surveying Instruments.

THE A. LIETZ COMPANY, SAN FRANCISCO.

It is becoming more and more a custom at this day, for the makers of the finer kinds of instruments and implements to issue manuals or treatises in which is supplied technical and other information, independent of and in addition to trade objects. In this manner it becomes possible to furnish at a nominal cost, and sometimes at no cost at all to readers, instruction and information more complete and valuable than can be found in common literature of the arts treated upon. Such information is not prepared by compilation, but by those practically skilled in both the construction and use of the instruments or implements dealt with.

Disclaiming all intention of flattering notice, we must pronounce the present work the most successful and complete attempt at this kind of literature that has appeared, comprehensive, modest, and written in a scholarly manner seldom attained, even in pretentious essays.

Our first thought on examining the book was of how a manufacture of this kind, and warranting such representation, could be successfully maintained on this Coast. But when the diversity and extent of engineering field work is taken into account, this is explained.

The manual is divided into four parts, the first containing a description of the manufacturing establishment, and the implements employed in making and adjusting instruments of all kinds, from the pocket compass that costs $8, to the alt-azimuth instrument that costs $1,400; transits, levels, aneroids, telescopes, and indeed all that is required by engineers and surveyors.

The second part describes the instruments and their peculiarities as here made, their care and correction.

This section is followed by one consisting of valuable professional treatises. One by Mr. Otto von Geldern, C. E., on Stadia Surveying; one by Mr. Hubert Vischer, C. E., on the Logarithmic Slide Scale; and a third, by Mr. Adolph Lietz, the President of the Company, on the Construction and Operative Features of Surveying Instruments.

Part IV is a list and description of the instruments made, with their prices, and is also a valuable section of the manual, because made up without fulsome claims, and as much in the interest of clients as of the Company.

The Company have for some years past been engaged in experimenting with aluminium, as a material for instruments, and have prepared a foundry in the works for that purpose. The result is most satisfactory, and this material is now extensively used, producing instruments of one half the usual weight.

The A. Lietz Company is composed of highly-skilled people that stake their qualifications and work against the world in this manufacture. They now enjoy a wide patronage, and have set an example of what capable and earnest effort can accomplish on this Coast.

The manual contains about 200 pages with fine photo-plates of the various instruments made, also the principal implements in the works. It is supplied for fifty cents a copy, which must be less than one half the cost of production. The edition is naturally limited by these circumstances, and we advise early applications for copies.

Consular Report.—No. 154.

JULY, 1893.

In this number Consul De Sallier-Dupin, at Nantes, France, writes of the sardine fishery of Brittany, giving statistics of the industry that are astonishing.

The fishing season for sardines lasts about five months, requires 2,500 boats, and 12,000 to 15,000 men in fishing, and 1,500 to 2,000 men with 10,000 women and children in the factories when the fish are packed. The expenditures for labor and material is estimated at $3,875,000.

The following is an account of the method of fishing:

"Before daybreak the fishing boats leave port to search for the shoals of sardines, many leave in the evening and anchor at sea. When a peculiar bubbling of the water reveals the fish the nets are immediately thrown. Each net is from 900 to 1,000 yards in length, about 3 yards in width, and black in color. On the upper part of the net are cork floats, on the lower part leaden sinkers to keep the net in an upright position.

The oarsmen, generally two in number, row always either against the wind or the tide. One man casts the net as the boat advances, while another throws the 'roque' into the water. The bait is an important feature of the sardine catch as it is quite expensive, and fishermen often lose a considerable quantity. It is made of the eggs of codfish or mackerel mixed with clay, and costs from $7.00 to $17.00 per barrel. That made of mackerel eggs is superior."

The price of sardines at Nantes is, for the American brands, 9.65 cents per box.

Consul-General Byers, at St. Gall, says Eastern Switzerland makes $20,000,000 worth yearly of machine-made embroideries, of which $7,700,000 worth is sent to the United States. Not more than five per cent. is made by hand now.

Consul J. P. Bradley, at Southampton, England, writes thus of American implements for agriculture shown there:

"The annual agricultural show is being held this year in Southampton, and I personally inspected the machinery department and conversed with those who have an expert knowledge of farm implements.

There were specimens of reapers and self-binders from three countries, America, England and Canada, all priced at about $225 list, with, of course, a percentage off. According to unbiased testimony, the American machine is lighter, simpler, and more convenient than any of the others, the cost of maintenance is at the minimum, and draft much easier.

American horse rakes are much neater, lighter, and about 25 per cent. cheaper than the English kinds, the American price list being $40, and the English price $50 to $60.

The American plow is very much superior to any other kind, particularly as a digging machine, being lighter and the shears and points more durable. The English makers can not properly chill points and other parts, their process rendering the metal very brittle, while the American process makes the iron tough and at the same time very hard. It is also susceptible of a high polish, which is another advantage. In certain localities wooden-beamed plows cannot be disposed of at any price, though of one kind, the Oliver chilled, of South Bend, Ind., 12,000 have annually been sold. I think if our manufacturers would adopt the style of iron-beamed plows the trade would be extended. The American style caused the English makers to imitate, as the old style was so heavy, and though it made a pretty furrow it did not disintegrate the soil, but pressed or packed it down, making the harrow do the rest."

The following notes from a communication, by Consul E. Bedloe, from Amoy, China, will have an interest on this Coast.

"A great industry in Amoy is the manufacture of paper. Despite the tariff and freight, many varieties of paper could be exported direct from Amoy to the Pacific Coast, if not to the Atlantic, and then sold at a very fair profit. Among these may be mentioned cheap wrapping paper, fine and fancy wrapping paper, blotters, envelope paper, and rough binders' and drawing paper. The Chinese do not use wood pulp in the manufacture. As a result their paper will last a century without becoming brittle.

American flour is very popular, more so than any other brand, and the demand increases every year. Originally San Francisco had almost a monopoly of the business, but the high rates imposed by the Pacific Mail injured the trade and drove much of it to Portland, Oregon. It may be doubted if flour from Oregon and Washington is superior to the California article, nevertheless such is now the general impression in the Chinese mind, and when they once form an impression it remains unchanged for many years. * * *

A fortune lies in store for the man who will discover some process for cheaply making wood proof against white ants. These pests are the curse of existence in Amoy, and every other tropical or subtropical city. Their voracity is incredible. They ate the framework of a new door in this consulate in three weeks. In the same period they almost consumed a large and handsome cabinet in the courtroom, and a heavy pine settee in the anteroom. Their work is invisible. They attack the wood from a mere point, through which they bore to the interior, and there eat everything until only a shell or film remains. Wood which will successfully resist these insect pests must be thoroughly charged with some powerful

chemical, both poisonous and nonevaporative. A solution of corrosive sublimate, chloride of zinc, arsenic, or antimony, would seem to meet the want.

American lumber is popular in China, and has been so for many years. It works easily and well with the primitive tools and methods of the native artisans. It is greatly liked by the merchant marine of the coast, and a supply of it is kept in stock by the New Amoy Dock Company and similar institutions. Dunnage, bilge soaked or kerosened, is very popular and brings about three times as much here as it would at home.

Canned goods are growing in demand. A great trade could be made in canning the cheapest grades of tomatoes, corn, and possibly peas. The cans should be square so as to save freight, and to allow the commercial Mongolian the empty tin for use as a box or waterholder. He utilizes the kerosene tins in this manner, and, after the oil is used, employs them as pails and pitchers, esteeming them so highly as to pay from 10 to 25 cents apiece for them. Neither the Chinese storekeeper nor his customer cares much for display, so that the canning factory would be spared the expense of the gorgeous chromos now pasted on every tin and case. All that would be necessary would be to stencil on tin and case the characters expressing 'the finest, largest and freshest tomatoes.'"

The Dodge Manufacturing Company.

Among the many fine circulars or souveniers that have reached us since the opening of the Chicago Exhibition, a first place must be given to that of the Dodge Manufacturing Company, of Mishawaka, Indiana.

This Company make mill gearing of one kind or another, especially rope-transmission apparatus and wooden pulleys, mainly, or indeed almost wholly, a "new manufacure."

The works, at Mishawaka, have been extended regularly since 1878, until at the present time the floor space occupied for the various manufactures is sixteen acres. The buildings are of stone and brick, made fire proof as far as possible. Sixty acres of ground are occupied in all, and the business is, on the whole, one of the most remarkable that has sprung up in this country.

The present "souvenier" is, in engraving, printing and allwise, an admirable example of modern art, and at the same time in good taste.

The Tri-City Trade Journal.

The publishers of the above serial have issued a sumptuous edition, descriptive of the city and environs of Rock Island, Ill., and the principal citizens there, embellished with 130 photo and other engravings. This work, which must have involved a great deal of expense, is executed with much taste, and while its chief value is naturally in the localities described, the subject is not without interest at this distance.

The city derives its name from an opposite island in the Mississippi River, where the U. S. Government maintains its largest arsenal for the manufacture of small arms, and other material for war. There are ten buildings in all, supplied by water power, obtained by damming the river above the island. The amount of power is computed at 4,000 horse power, and the investment in the arsenal at 12 to 15 million of dollars.

The *Tri-City Trade Journal* is issued simultaneously at Rock Island, Moline and Davenport.

Patent and Trade Mark Laws.

Chief Examiner F. A. Seely, of the U. S. Patent Office, at the request of the Commissioner of Patents, has submitted a report on trade mark laws, and international conventions affecting legislation on trade marks in various countries; also a synopsis of the trade-mark laws in the principal commercial countries included in the convention of Paris in 1887.

This report is in compliance with a resolution of the U. S. Senate, of March 3d, 1893, and while presented through the Commissioner of Patents is a document of the Department of the Interior.

No better authority could have been called in than Col. Seely, who, in addition to his administrative duties, has made a study of laws to protect inventions and trade marks.

The report will be found of value to inventors, lawyers and patent agents in this and other countries. Copies can be procured by addressing the Department of the Interior, or the Commissioner of Patents, at Washington.

"INDUSTRY."

JOHN RICHARDS, EDITOR.

ISSUED MONTHLY BY THE

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In the present and future issues of INDUSTRY, notes, comments, news, and other than "permanent" matter, will be made up with the advertising pages, so that all advertisements will face reading matter. The permanent or binding section will not be disturbed, the pages being numbered as heretofore. The purpose of this is two-fold, it separates ephemeral matter from the body of the Magazine, and gives advertisers the advantage of having their space seen and examined in every issue. The facing matter, when possible, will be made relevant to the subject or class of matter to which the advertisements pertain.

THE PRESENT FINANCIAL PROBLEM.

BY AN ENGINEER.

[Communicated.]

The financial problems now confronting the people of the United States are profound and broad. That these conditions are affected to a minor degree by the "silver question," is not to be denied; although the "grain question," the "dairy question," the "poultry question," and even the "potato question," outrank the silver question in general value and importance, from either one of two important standpoints — first, the number of persons employed, and second, the market value of the products.

The only reasons why the silver question is so prominently thrust forward are: First, the so-called financiers are delighted to

have an object with which to divert the attention of the people from the real cause; and secondly, because the Government has been wheedled into buying up and hoarding silver to such an extent that over $300,000,000 are stored in Government vaults. Were any other commodity stored to an equal amount, the market for that commodity would be seriously threatened. What would be the effect upon the market for steel rails if the Government had on hand $300,000,000 worth?

That the financial crisis is not a local affair, due to the tariff or to the "purchasing clause of the Sherman Act," is also apparant, for the financial stringency is affecting countries not dependent upon our laws or our silver, even to a remote degree. We therefore must look abroad for the initiating cause, and to conditions at home which render that cause of severe effect.

One significant fact is that in recent years the great banking houses of the Rothschilds have acquired the largest and most productive gold mines of the world, aggregating in their annual output about $50,000,000. This firm have long controlled the largest tangible volume of the gold currency of the world. Now with the acquisition and control of vast gold-producing properties, it is natural that they should be desirous of doing two things: First, to enhance the value of the volume of gold in their hands, and second, the value of the annual output of their mines. Therefore, they began a few years since to call in and hold as much outstanding gold as possible. This brought up with a round turn the most risky of the great banking institutions of England — Baring Bros., and gave the Bank of England such a shaking that only prompt and vigorous propping kept that venerable institution from toppling over.

In thus endeavoring to corner the gold market, the Rothschilds only followed out the general bent of "trusts" in steel, coal, sugar, grain, flour, oil, whiskey, and other commodities.

Now, what relation has this to the financial condition of the United States? The vast corporations and trusts of the United States have, in the past quarter of a century uttered a volume of bonds and stocks beyond the actual grasp of the mind, and only within the power of numbers to express. The securities have been sold in a large measure in Europe, thus furnishing the money to perform the work contemplated by the corporations. The stock or shares have been kept by the organizers and promoters, and are mainly used as a basis for the gambling operations of Wall Street and the minor stock exchanges throughout the country. The

aggregate value of bonds and stocks thus uttered is as follows:

Railroads, $10,000,000,000 (ten billions); trusts and corporations controlling steel, oil, water, gas, whiskey, beer, steamboats, telegraph, telephone, twine, cordage, sugar, coal, iron, copper, lead, etc., $10,000,000,000 (ten billions); so that we here have the vast sum of twenty billions of dollars, back of which lies an actual invested capital of not over $5,000,000,000 (five billions). The remaining fifteen billions stands as the "*evidences of indebtedness that has never been incurred.*"

Now these vast corporations and trusts have, and are yet endeavoring, to serve the communities in and upon which they subsist, on the basis of reaping a sufficient revenue to pay interest upon the bonds, dividends upon the stock, and large, if not enormous, salaries to their higher officers. Thus attaching an apparent value to the stocks, and even to the "watered" stocks.

Upon the calling in of gold in Europe an era of economy was commenced, resulting in lessening our shipments of merchandise there, and an increase in the balance of exchange against us. Added to this comes the calling in of such gold as European countries can take from this country, and the sale of "American securities" by European holders, there at once followed a stringency in our money centers, and a desire on the part of banks to be able to meet their obligations, many of which rest on "collateral" deposits of the inflated stocks and bonds. These began to shrink until the shrinkage amounts to thousands of millions. This is really not a loss of actual wealth, but the fact that for years these stocks have paid dividends, and by this means have permeated and weakened every line of industry, causes a wide-spread collapse in everything when these fictitious values shrink.

Because the A. B. C. R. R. ceases to pay dividends upon its unpaid-up stock the railroad is none the less able to serve its purpose; it has lost no bridges, no rolling stock or road bed, it is just as serviceable as ever, and no actual wealth nor capacity to serve the country has been parted with nor destroyed. Even if it has been compelled to carry freight and passengers at lower rates, this is not a loss; indeed the bulk of American citizens regard this as a gain, for it is not to their advantage to have to pay rates sufficiently high to enable the railroads to declare dividends on stock which has never been paid up, and interest on bonds which have largely been sold to an inside ring at ruinous discount. This railroad, like others, not being a producer must call upon the producing indus-

tries to supply the money wherewith to meet its obligations. Now as most of these obligations are not real, the producing industries must become impoverished through this unequal and unjust drain.

Because the Cool Spring Water Company's stocks fail to yield their semi-annual dividend on capital that has never been paid up, that monopoly is none the less able to supply its long-suffering consumers with water. Only the breakage of its flumes and mains, or other actual damage, save decrease in rainfall, can impair its capacity to serve its customers at "legal" rates.

Because the Gambrinus and Pretzel Brewing Syndicate fails to pay its quarterly dividends on watered stock that corporation is none the less able to make its regular output of "steam" or "vacuum" beer, into which aloes and other cheap bitter extracts enter more largely than hops.

Because the Bourbon and Rye Distillery Trust finds that it must with-hold its dividends on the last $5,000,000 stock issue (which it issued to put in an additional $20,000 still, and to keep its dividends below the legal rate established by the State laws), that vast trust can still get as many gallons of "rye whiskey" out of a bushel of corn as ever.

It is the shrinkage in the apparent values in these vast over issues of stocks and bonds, these "evidences of indebtedness which has never been incurred," which has brought our country well nigh a state of general collapse. We are actually no poorer, none the less patriotic. Our country's vast resources are just as great, and yet every branch of trade and industry has been more or less paralyzed, much suffering has been incurred, and more must follow before we reach our normal condition of happiness and prosperity.

It behooves us therefore to look carefully and honestly into the causes, and to use first such temporary emollients as will allay actual suffering and want; and secondly, to apply the proper remedy to the seat of disease that it may not break out again with increased violence at a time when we may be less able to stand the attack.

In order to freely comprehend the magnitude of the evil with which we hope to grapple, we will use a homely illustration, for it is not the banker, the stock dealer, the promoter and the financier that this article is intended to reach, they know it all already, and will cleave unto their idol, the golden calf, as of yore; but we hope to reach the thinker too busy bread-winning to study the case for himself, but whose sound common sense needs only the fundamental facts to form a correct opinion, and we hope to act thereon.

Let us suppose that a "farmer" desiring to purchase 160 acres of finely and highly-improved land, worth at least $10,000, were to go about the acquisition as follows:

"First, I will purchase 10 acres, and announce the scope and "extent of my enterprise, and then issue to myself $10,000 worth "of stock. Then I will issue $10,000 worth of first mortgage "bonds, and from the sale of these I will buy the remaining 150 "acres. Then I will issue $10,000 second mortage bonds (upon "which of course I will pay a higher rate of interest, and sell at a "larger discount on their face value). With these funds I will "stock and work my farm, and charge enough for the produce as "will enable me to pay the interest on the bonds, and a fair rate of "dividend on the stock which I hold. Later on when my stock "pays dividends I can put just a little less than one half of it on "the market in good years when the crops are fine, and by judici- "ously 'doctoring' the next year's bad prospects, buy it in again at "a reduced figure, and so on. Now my plan has the advantage of "doing away with any great economy and industry on my part, and "puts the paying off of the bonds on posterity, who will, through "my shrewdness, be better able to pay them."

We will imagine all our farmers to have practiced this skillful plan of financiering for as long a period as the corporations, syndicates and trusts have, and by thus serving their country upon this inflated basis to have absorbed, as a natural consequence, the bulk of the wealth of the country. The longer lived of these to have covered up portions of their indebtedness by a new set of bonds called "blanket mortgages," and in order to avoid paying a larger dividend than the law allows, we will suppose each to have built a wing to his barn costing $500, and issuing to himself $10,000 worth of stock, thereby reducing his dividends to the legal six per cent.

Now in what measure does this proceeding differ from the basis upon which 90 per cent. of the corporations and trusts couduct their business? Why should their stock and bonded indebtedness reach the enormous sum of $20,000,000,000 when their *actual capital* invested in real estate, improvements, road bed, plants, rolling stock and working funds amounts to only $5,000,000,000? What right have they to incur an indebtedness which they can never pay except by illegal and extortionate methods? Why should a corporation have the power to do that which a free American citizen would not be permitted to do did he dare — incur an indebtedness vastly

greater than his ability to honestly pay? Why should corporations be permitted to do that which this great Government dare not do — incur an indebtedness vastly greater than its legitimate resources?

These vast monopolies of transportation and syndicates of manufacturers in serving the communities in which they exist upon this inflated basis have naturally absorbed the greater portion of the wealth, and this wealth has come entirely from the producer, who has not had the "financial" advantage of "watering" his stock, and selling his bonds in Europe.

Only our unparalleled resources and vigorous growth have permitted us to withstand the strain of raising up a horde of monsters, greater than ourselves, greater than our laws, greater than our Government; and who are not content with absorbing all the wealth and substance of the country, with laying under tribute every branch of productive industry and labor; but who must make, interpret, and administer our laws. In what court can the rights of the man stand as against the "rights" of the corporation? Guilty of every crime known to the law, from treason to petty larceny, where is the corporation that has been made to answer the penalty? Even when human life has been carelessly sacrificed what adequate fine has ever been imposed and enforced?

Here then is the true remedy. Subordinate corporations to the law. Deprive them of the self-assumed right to issue money, for their bonds are nothing else. Forbid the issuance of bonds and limit their operations to the issuance of stock to the extent of the actual requirements of their legitimate work, and *require every dollar of this stock to be fully paid up*, and honestly spent in legitimately developing the work or project contemplated. The schemer, the promoter, the so-called financier will recoil in horror from such a proposition, and will deem its terms monstrous in their severity; but who would not rather own 100 shares of stock in a well-considered public work, or community undertaking, fully paid up, with no mortgage bonds, no fluctuating values, no "bulls" and "bears" of Wall Street to gamble in it; than 100 shares of stock which was never paid up, bonded to double or triple its value, and the butt of every phase of financial trickery and thievery?

"There is no royal road to learning." The American people have had this lesson well impressed upon them. If they have learned it well, good will come of this "depression," this "shrinkage in values." Only sound and legitimate investments will find favor in the future. The wild desire to grow wealthy without work-

ing for it will be checked; the insane era of speculation, inaugurated at the close of the war, will be over. Men of all classes will have learned an important civic lesson, which if forgotten or unheeded will bring disasters that will attack not only our fictitious wealth of stocks and bonds, but our real wealth of resources and power to develop, of peace and good government.

The silver question yet remains. What to do with the silver produced in our mines and imported is an important issue, and one that at this time must be squarely and honestly met. When we consider the universal use of silver as a subsidiary coin, no nation of Europe nor Asia that can do without it any more than they can do without gold, its importance becomes apparent. Travel in Germany, England, France, or any other part of Europe, and you cannot stop at a wayside inn and pay for your meal without silver; you cannot pay the driver of a coach without silver; stop a night at any guesthouse, and offer gold or a bank note and your change will be handed you in silver. The volume of the little debts daily paid to the grocer, the baker, and the butcher, vastly exceeds the transfers of gold from bank to bank, or from debtor to creditor; consequently the talk of actually "demonetizing" silver is mere jargon, the world never has, and, so far as human foresight can go, never will get along without silver money. The nations who have "legally demonetized" it use it without stint in daily transactions, and pay more debts between man and man than is actually paid with their hoarded gold. Let the United States boldly coin silver, and stack it away in vaults, and issue silver certificates, *payable in silver*, for every dollar.

A million or 10 million dollars in silver certificates is good enough for any American, particularly when a silver dollar, bearing the guarantee, motto, and coat of arms of his country upon its face, is back of every dollar of the issue. How much better are $10,000,000 of these silver certificates than $10,000,000 of National bank notes yielding 4 per cent. interest and 10 per cent. profits, both of which the people pay? What if we do stack up in our vaults the gross silver output of not only our own country but that of Mexico and Peru to boot, how many years of this sort of financiering will it take to deprive Europe and Asia of their annual quota of silver for both coinage and the arts? How long can the "financial world" get along without the silver of the two Americas?

These silver certificates, with silver to back them to their full value, furnish as safe, a much better and *less costly* basis for a circu-

lating medium than the National banks can utter. When the tender care of the National Government for the national bank is analyzed we find that the banks get more care taken of their interests than is taken of those of the people, and the relation between the *National* banks and the *National* Government appears more intimate than the names imply.

In order to put a little of the three hundred million silver dollars now in the U. S. Treasury into circulation, let Congress appropriate $100,000,000 for river and harbor improvements, hire the laborers directly and pay every one of them in silver dollars. It is not likely that the idle workingmen of this country will object; as long as one of them has a silver dollar in his pocket he will not go hungry nor suffer for a night's shelter in any State in this Union, and, so far as good results go, witness the improvement of Columbia River at far less cost by day labor than contractors offered to do the work for. The loudest objections will come from transportation monopolies, whose agents in Congress have in the past kept appropriations for this purpose at the lowest figures.

There will by this means be put in circulation the silver now useless, and for which the Government has been adroitly wheedled into paying for in gold, thereby doubly playing into the hands of the moneyed class. In addition we will have inaugurated a policy which will, first, offset the financial rule or ruin policy of the "gold bugs," and, second, we will have put in force an *American policy* which the financial world will be forced to follow.

San Francisco, September 30th, 1893.

Yachting people having now got so far away from what may be called seagoing vessels in their recent designs, it is about time the mechanical engineers took up the subject of these "racing machines," and designed some kind that will climb out of the water and skim over the top. The recent machines, such as the *Pilgrim*, *Jubilee*, *Colonia*, *Vigilant*, and *Valkyrie* have little in common with ships or boats of normal build, at least not more than the "proa" of the South Seas, which, if properly built, will outrun any of them. The proa has two hulls, and certainly in this manner there can be obtained the largest amount of stability with a given immersed section. There is nothing but amusement to be got out of modern racing yachts, they have passed out of the field of what we call navigation.

COUNTRY ROAD CONSTRUCTION.*

EXCERPTS FROM NOTES COMPILED AND PREPARED FOR THE STATE ROAD CONVENTION OF CALIFORNIA.

BY JULIUS H. STRIEDINGER AND OTTO VON GELDERN.

* * * In Hanover the width of wheel-tires for four-wheeled freight wagons is laid down by law as follows:

When laden with 0.8 tons to 2 tons	2-inch
" " " 2 tons to 3 tons	2¾-inch
" " " 3 tons to 5 tons	4⅜-inch
" " " more than 5 tons	6-inch

For two-wheeled freight cars one half of these weights is permissible. The transportation of freights exceeding 7 tons, and of machinery of more than 10 tons in weight, is only permitted under certain conditions, which include the obligations to repair all damages done to the roadway, and to attend to all required re-enforcing of the bridges to be passed, etc. The tires should be neither concave nor convex.

This law was very unpopular in Hanover. On that account a new bill was lately introduced making the width of tires dependent upon the number of draught horses hitched to the freight wagon. Such a law is in operation in Bavaria. It reads as follows:

Minimum width of wheel tires of	2-wheeled carts,	with 2 horses,	4.13 in.
" " " " "	2-wheeled "	" 4 "	6.18 in.
" " " " "	4-wheeled wagons	" 2 "	2.60 in.
" " " " "	4-wheeled "	" 3 to 4 "	4.13 in.
" " " " "	4-wheeled "	" 5 to 8 "	6.18 in.

Since over three-fourths of our roadways in California are dirt roads, which, even when well compacted, are readily destroyed by knife-like tires, it is all important that the law regulating the width of wheel tires be strictly enforced at once. There is certainly no use of spending money on roadways without entirely doing away with all narrow-tired vehicles.

But since the sudden and unconditional execution of the wheel-tire law is looked upon in many quarters as an act of hardship to the community, it has been proposed at the Convention, and we warmly second the proposition, as an initiatory step to making and

*Extracts from a paper read before the Technical Society of the Pacific Coast, October 6, 1893. Republished by permission.

preserving good roadways, that the different counties buy up and destroy all existing narrow-tired vehicles, insisting at the same time upon the exclusive introduction and employment of vehicles provided with wheel tires of approved width in future.

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THE GRADES OF ROADWAYS.

In order to insure a dry condition of roadways, it has been customary to build them somewhat higher than the land over which they pass; the necessary material for that purpose is obtained by an increase in the cross-section of the side ditches. It is requisite that the sub-grade of the roadway lie above the mean water level of the side ditches, so that a good foundation for the topping is assured.

In determining the proper grade of a highway it must be observed that the cuts should equalize the fills as nearly as possible, wherein the fact is to be considered that the material in a fill, though it be tamped, will not, for some time, pack as closely as in the original excavation or borrow pit. The excess depends upon the nature of the soil and the height of the fill, and varies considerably; the mean may be taken at 5 per cent.

The opinion has been expressed that an undulating profile of a highway is of some advantage, for the reason that the alternating increase and decrease of the tractive force required will be less tiring to the horses. This view is obsolete. It is now assumed that horses will tire less on a horizontal than on an undulating stretch of road of the same length. Especially in the ascent of a hill it should be the problem never to lose an elevation that has once been gained, in order to reduce the required amount of mechanical work to the lowest minimum, unless it should prove that in carrying out this principle excessive amounts of earth work would be required. A loss of elevation should be avoided as much as possible.

Another reason given for the adoption of an undulating profile is that a better drainage is effected there than upon a horizontal plane. Sganzin went so far as to advocate alternating grades of at least $\frac{1}{123}$. Wherever the topography does not in itself indicate an undulating profile it is certainly objectionable to construct one artificially. The side ditches, however, should be made with alternating rises and falls, so that they may lead the road drainage to the nearest main lateral drains.

THE GREATEST ADMISSIBLE AND CUSTOMARY GRADES.

The maximum admissible grades in highway construction are usually prescribed by legal regulations in most countries.

In Prussia the following standards are laid down :

a. In mountainous country 1 in 20, (5 per cent.)

b. In hilly country 1 in 25, (4 per cent.)

c. In level country, 1 in 40, (2½ per cent.)

Greater demands are made in Hanover. The technical regulations of 1860 call for the following grades, corresponding to *a*, *b* and *c*; 1 in 24, 1 in 30, and 1 in 40.

In Baden the maximum grades are :

Main highways with large traffic, 5 per cent.

Secondary roadways, 6 per cent.

Mountain roads that do not belong to the class of main highways, 8 per cent.

On curves in highways, 2 per cent.

In Brunswick the roadways in the Harz Mountains have a maximum grade of 1 in 18, in the hilly country 1 in 25, and on the plains 1 in 33⅓.

Schleswig-Holstein allows grades of 1 in 24 (usually) on main highways, and 1 in 18 on secondary roads.

The old highways of Norway were very steep. Recent regulations prescribe a grade of 1 in 20 for main, and 1 in 15 for secondary roads.

If the tractive power of the horse is considered, and it is desired to avoid additional draught for a certain maximum load, then the highest permissible grade for that load should not be exceeded.

A certain expression has been made use of which shows the relation of the tractive force to the weight of the load. It is $K = \mu Q + (G + Q) \tan. \alpha$, in which K represents the mean tractive power of the horse, taken at $\frac{1}{5}$ of its weight, equal to 165 pounds ; Q the load, including the weight of the wagon ; G the mean weight of the horse, $165 \times 5 = 825$ pounds ; α is the angle of inclination, and μ the coefficient of resistance to road traction.

We shall refer to this formula again later on, where its derivation will be more fully explained. Q the load in the above expression, is equal to :

$$\frac{K - G \tan. \alpha}{\mu + \tan. \alpha}$$

and this form has been utilized for the computation of the following

table, showing the load (with vehicle) that the average horse, exerting an average tractive force, can pull up a continuous incline having various grades and different coefficients of resistance, without requiring reinforcement at any time.

While the above formula holds good for all inclinations shown in the table, it must be stated that it is no longer applicable for excessive grades, for the tractive force in reality diminishes so rapidly that at an angle of 30 degrees it becomes zero.

Grade	Coefficient of Resistance (μ)					Grade	Coefficient of Resistance (μ)				
tan. α	$\frac{1}{50}$	$\frac{1}{30}$	$\frac{1}{20}$	$\frac{1}{10}$	$\frac{1}{5}$	tan. α	$\frac{1}{50}$	$\frac{1}{30}$	$\frac{1}{20}$	$\frac{1}{10}$	$\frac{1}{5}$
	Load Q in Pounds.						Load Q in Pounds.				
0.000	8250	4950	3300	1650	825	0.022	3497	2654	2040	1204	661
0.002	7425	4627	3141	1601	808	0.025	3208	2476	1925	1155	642
0.004	6737	4335	2994	1555	793	0.028	2956	2315	1819	1109	623
0.008	5657	3835	2731	1467	761	0.033	2599	2078	1660	1036	591
0.010	5225	3620	2612	1425	747	0.040	2200	1800	1467	943	550
0.012	4847	3424	2502	1385	732	0.050	1764	1483	1238	825	495
0.016	4217	3079	2300	1309	703	0.066	1285	1113	953	666	415
0.020	3713	2786	2121	1237	675	0.100	687	619	550	413	275

It is readily seen how very detrimental ascending grades are to the traffic, and how very considerable the required amount of tractive force becomes to overcome them. On a well-paved roadway having a coefficient of resistance of $\frac{1}{50}$ it is necessary to expend nearly five times as much tractive power to move a load on an inclination of 5 in 100 feet than would be required on a level.

* * * * * * * *

Another point of great practical importance in the determination of the grades is the velocity with which the traffic is to be carried on. It is assumed by Bockelberg that a well equipped coach, in ascending a roadway having a grade of 1 in 22, cannot accomplish long reaches with the horses at a trotting gait. That is, such a grade is too steep for anything above a fast walk ; on inclinations of 1 in 30 to 1 in 33 the trot may be kept up for a longer time, but for a contin-

uous run at this gait the grade should not exceed 1 in 36 to 1 in 40.

In descending at such a speed without brakes, a grade of 1 in 16 is considered as dangerous ; 1 in 20 as not advisable ; 1 in 22 necessitates a careful management of the animals and moderation of the speed ; 1 in 24 on well-paved roadways requires that the horses be held firmly in check ; and only at 1 in 36, and under conditions at 1 in 40 to 1 in 45, is it safe to travel over long stretches at a trotting gait without the application of brakes.

* * * * * * * *

CROSS-SECTION OF COUNTRY ROAD.

The limits in width of artificial country roads lie between 16 and 50 feet ; of the former width, about 12 feet — exceptionally 10 feet— are utilized for the macadamized part, and two feet, or three feet respectively, for the banquettes or shoulders. To these dimensions are to be added the widths of the ditches.

Bockelberg says desirable widths for the metaled part of roads are : with slight traffic, from 11 ft. 3 in. to 13 ft. 3 in.; with moderate traffic, from 13 ft. 3 in. to 15 ft. 3 in.; with larger traffic, from 15 ft. 3 in. to 18 ft. 9 in.

The widths of French roads, as given by Sganzin, are as follows :

	Widths of footpaths or Dirt-Road Portion.	Widths of Metaled Roads.	Total Width.
Main roads	21 feet 9 inches	21 feet 9 inches	65 feet 3 inches.
Department roads	9 " 10 "	19 " 8 "	39 " 4 "
Principal county roads	6 " 6 "	19 " 8 "	32 " 8 "
Common roads	5 " 0 "	16 " 5 "	26 " 5 "

In Holland : width of metaled portion of road, 14 feet; width of raised banquettes, one on each side, including their sod revetment, twice 12 feet, total width, 38 feet. On roads of less importance these dimensions are reduced to 10 feet + twice 6 feet = 22 feet.

F. Collingwood, E. P. North, and J. J. Owen, say :

"We think the width of road metal or other covering should not be less than 16 feet, except where all traffic is very slow, where 12 feet may answer. This is a matter for the judgment of the engineer."

Very narrow roads are disadvantageous, because they wear badly. Since on them the draught animals prefer the middle of the road, ruts on the side and a hog's back in the middle are soon formed. Experience proves that, within the usual limits of road widths, the expenses for maintaining broad roads are less than for

narrow roads, if both are subjected to the same amount of traffic.

The widths of our California country roads vary from 30 to 60 feet. The latter width is wasteful, because the largest sized agricultural vehicles known to the authors can safely pass each other, even on curves of 90 feet interior radius, on roads 40 feet wide. Thirty-five feet of roadway width is enough for a regular traffic of four ordinary vehicles. We, therefore, are in favor of limiting the width of our California country roadways in agricultural sections to 40 feet, which dimensions might be increased to 50 feet near large cities. Good roadways of from 16 to 35 feet in width should meet all just demands in non-agricultural districts.

To carry off the rain water as speedily as possible, and thus to prevent the soaking of the subsoil, a lateral fall or side slope is given to the road. Of course, this end would be better reached by steep than by gentle slopes; but it is to be remembered that steep side slopes render the traffic difficult, and on roads frozen slippery become seriously dangerous. Usually the middle of the road is rounded like an arch, while the sides form inclined planes.

Exceptions to this rule are found on well constructed mountain roads, where, in order to reduce the danger of vehicles sliding toward the precipitous valley side, the topping forms an inclined plane pitching toward the mountain; in which case the drainage from road and mountain slopes is conducted by pipes or cascade culverts under and across the roadway.

Since the shed of the surface water follows the line of greatest descent, which is composed of the longitudinal and lateral falls of the road, the side slope should be somewhat regulated by the gradient of the road; less side slope should be given on steeper road grades. Still, enough pitch must be allowed to prevent the rain water from running off nearly in the direction of the road, in which case it might cause the washing out of the topping. Umpfenbach observed on roads where these rules were violated, that on a grade of $\frac{1}{72}$ the surface was muddy, on grades from $\frac{1}{48}$ to $\frac{1}{36}$ clean, and that on grades of $\frac{1}{18}$ the roads began to deteriorate on account of the washing out of the binding gravel.

Nessenius gives the following table of suitable side slopes for macadamized and dirt roads of different grades.

Grade of Road.	Side Slope, Macadam Road.	Side Slope, Dirt Road.
0%	7%	5%
0% – 3½%	5½%	3½%
3½% and over	4%	1½%

CURVES.

The smallest radius of curvature allowable on roads, chiefly depends upon the maximum length of teams frequenting the road. Theoretically, taking the maximum length of team, viz., length of vehicle and its four-horse span equal to 49 feet, in order to retain said team on a macadamized or improved roadway-crown 12 feet wide, the minimum interior radius of curvature should be about 100 feet; 75 feet when 16 feet, and 66 feet interior radius when 18 feet wide.

In Saxony the permissible minimal radii are as follows: on principal roads, 82½ feet; on roads on which logs are transported, 100 feet; on ordinary country roads, 39½ feet.

In France on the Orleans roads the minimal radii are: on main roads and department roads, 100 feet, but generally 165 feet; on principal country roads, 49½ feet.

We would propose for our California country roads of 40 feet width, a minimum interior radius of curvature of 90 feet, and of 50 feet width a minimum interior radius of 81.0 feet.

FINAL LOCATION.

It would go outside of the proposed programme to enter here in a discussion of all the technical and financial points to be weighed when making the final choice between the different possible road routes to connect important points.

The general principles followed in railroad location hold good here also. Make the line as short as practically consistent with easy grades, gentle curves, good drainage, cheap supply of material and lightest work in building.

The engineer's report on the construction of a proposed new road should be accompanied by—

1. A general map on a scale of from $\frac{1}{20000}$ to $\frac{1}{200000}$.
2. A detailed map on a scale of from $\frac{1}{600}$ to $\frac{1}{5000}$.
3. A longitudinal section on a scale of the detailed map as to horizontal distances, and on a scale twenty-five times larger as to elevations, and figured with reference to established bench marks.
4. Cross sections where needed for a thorough understanding of the proposed improvements.
5. Designs of required culverts and bridges.

CONSTRUCTION OF NEW BROKEN STONE ROADS.

Fillings made with sandy soil usually receive slopes with inclinations of 2 base to 1 perpendicular, and when done with better soil, 1 on 1½. More gentle slopes are required where the roadbed is exposed to high waters or waves. Steep hill slopes that might cause a sliding of the fill, should be cut into steps before the roadway embankment is placed upon them. Excavations for foundations receive slopes somewhat steeper than 1 on 1½, consistent with the character of the soil; with sound rock, slopes of 1 on ½ are usual.

If on long slopes the velocity of the running storm water is greater than the nature of the soil will withstand, the slopes are terraced, that is, they are provided with horizontal offsets, benches or bermes. If the depth of the excavation does not exceed 8 feet, the slope usually has a berme at the height of the crown of the road. In deeper cuts the bermes should be vertically distant about 7 feet, beginning from the bottom of the ditch. More perfect drainage is attained by giving the benches a cobblestone gutter on the outer side to receive the surface water from the portion of the slope above them. These gutters discharge by means of paved drains into the ditches.

On swampy soil complete success in filling is assured by replacing the muck with sand. The same can be accomplished by dumping sand through an excavation in the sward, until the muck is forced aside and the sand has reached the solid ground below. In most cases, however, particularly in bogs of great depth, this method is too expensive for application.

If above the very soft ground there should lie a bearing stratum, then the roadbed might be constructed on it with very light peat. This filling should only be high enough to keep the rising ground water from reaching the subgrades. On both sides of such roads benches are left, often of considerable width. The side ditches outside of these should be made very broad and shallow, and have a free outlet.

DRAINAGE.

The drainage of fat, wet soil is effected by means of tiles. The circular tiles are best laid lengthwise to the track on each side of it, and not less than 18 inches below the subgrade. They have an average fall of about 1 in 100; minimum fall 1 in 1,000. At short intervals, say from 36 to 100 feet distant, are placed cross drains to

discharge the water into the side ditches. These cross drains receive a greater fall, say up to 1 in 30. Generally 2½ to 3-inch pipes are sufficient. It is advantageous to bed these tiles in well-rammed brick fragments, and to cover them with road metal. Be certain that the tiles are correctly laid, and that nothing interferes with their free discharge.

SIDE DITCHES.

Side ditches are provided to dry the main body of the road, to drain off the rainwater, and to enclose the road. Ditches should be employed in connection with road fillings of less than 20 inches in height, and in all excavations. The ditch slopes should be at least 1 on 1½, exceptionally 1 on 1. The interior slopes of side ditches are, of necessity, flatter with roadways constructed and maintained with road machines, the maximum attainable dip of the scraping blade of the pattern in use limiting the steepness of the slope. Width of ditch bed at least 18 inches, depth of ditch from 20 to 40 inches. The water surface in ditch should not reach to subgrade, but remain at least 12 inches below the crown of the road. The longitudinal fall of the ditch follows the configuration of the general topography, that is, the natural drainage. When the latter is to be aided artificially, grades of not less than 1 in 800, or still better 1 in 500, will usually answer.

In absorbing soil less fall is sufficient, and in certain cases even level ditches are permissible. The slopes of the ditches must be protected where the grade is considerable. This can be accomplished by sod revetments, rip-rapping, or paving.

In mountainous countries, or deep cuts, paved gutters of from 30 to 60 inches in width are used in place of ditches; they are also preferable in all narrow passages. Grade of paved cobble stone gutters should be from 1 in 100 to 1 in 150.

CULVERTS, CANALS, BRIDGES.

The drainage from the roads ought to discharge speedily into existing creeks and rivers. To this end it is often necessary to conduct the water across the road-bed. Box-culverts used for this purpose, should have not less than 20″ × 20″ cross-section, and if pipes are used, they should have a mininum diameter of 10 inches. In districts suffering little from severe frosts the top of such drains may be situated 24 inches below the crown, otherwise 30 inches.

In preparing designs for new country bridges the weight of a ten ton steam road roller should be considered.

CHOICE OF STONE ROAD COVERING.

When treating the question in what manner a stone road should be constructed, the existance or absence of suitable road building materials, the first cost of pavement and charges for maintenance should primarily be considered. If that does not decide the choice, the following observations will assist in solving the problem.

Stone paved roads owe their solidity and durability to the larger sized stones that form the covering, which toppings are particularly suitable for heavy and important traffic. Stone paved roads are preferable in towns and villages, for the reason that they cause little dust and mud. They are also advantageous in sections which are very distant from the place of stone supply, and where on that account the cost of dressing the stones in the quarry is insignificant in comparison with the heavy freight charges, because in the construction and especially in the maintenance of a stone paved road, less material is required than for first class broken stone roads.

Although the first cost of stone paved roads is higher than that of another character, the light repairs necessitated by the former make them rather cheaper in the end. The broken stone roads on which much surface wear and tear takes place, are more suitable for light, rapid transit than for heavy traffic. It is claimed that they keep better on unstable ground. But, certainly, in damp sections, as, for instance, in woods, and on very moist subsoil, broken stone coverings are not suitable, for when wet, they suffer particularly by the traffic; under such conditions, stone paved roads are preferable.

Again, the repair of broken stone roads is always annoying to the traffic. Broken stone roads require careful maintenance. When neglected they suffer to such a degree as to become useless in a comparatively short time. The cost of reconstructing spoiled broken stone roads nearly reaches that of the original construction. Hence, on inferior and distant roads, which lack the benefit of competent supervision and maintenance, cheap stone paved roads are preferable, for, even when badly maintained, they don't go to entire ruin, and under the most unfavorable circumstances always offer suitable material for rebuilding.

The advantages of broken stone roads are their comparatively low first cost. Again, they offer, when somewhat cared for, a smoother surface than the average stone pavements, for that reason they present less tractive resistance to wagon traffic, are preferred for passenger traffic and cause less noise.

VITRIFIED BRICK ROADS.

Vitrified brick roads are unsuitable for heavy traffic, on account of the small resistance the clinkers offer to crushing, but they answer very well for light traffic. By reason of the usual high price of vitrified brick, this kind of a road is only found where natural stones are wanting, or where their use becomes too expensive on account of freight charges. Again, since clinker roads require a thin sand covering for their protection against rapid wear, they are best suited in sheltered localities.

Clinker pavements were first used on an extensive scale in Holland, from where they were introduced into Prussia. There these roads give great satisfaction and appear to cost less than roads paved with imported stone.

TRANSVERSE CONTOURS OF STONE ROADS.

For narrow roads a basket line whose flattest part forms the crown of the road is suitable. For broad roads two gently inclined straight lines, rounded off by a short circular arc at the center of road, give a good form.

Nessenius states that gravel roads of 11½ feet width, having a flat arching of $\frac{1}{36}$ of road width as total rise, wore better in Hanover than similar roads having a transverse contour of two tangents joined by a short circular arc.

The curvature of broken stone roads must be all the greater, the poorer the road metal, for it is more difficult to cause the shed of the storm water from uneven and dirty roads than from smooth coverings. On level grades the total rise of $\frac{1}{29}$ road width is suitable for the average broken stone road with circular transverse contour, and of $\frac{1}{48}$ on grades exceeding 1 on 36.

With vitrified brick roads the total rise should not exceed $\frac{1}{40}$; $\frac{1}{60}$ being usually taken.

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BREAKING STONE FOR ROADS.

The stone ought to be broken in cubical pieces of about equal size. Flat and splintery pieces are objectionable, because the strength of fragments diminishes the more they differ in form from cubes. The road metal should not be broken finer than is positively required, because the smaller the fragments the greater the wear and tear of the road-covering they form.

The road metal can be prepared by hand. In this case the laborers use for stone breaking, either short handled heavy hammers with which they break, in a sitting posture, the stone on a larger stone — the anvil; or long handled lighter hammers with which they strike in a standing posture. Each laborer is provided with gauge rings through which the broken stones must pass. The average amount of stone broken by a good stone breaker is according to Codrington as follows:

Hard silicious stones and igneous rocks, 1 to 1½ cubic yards per day; granite ½ cubic yard per day; river gravel and field stones, 3 to 4 cubic yards per day.

It is claimed that more work is done with the long handled striking hammers than with the short handled heavier hammers, but that the stones broken on the stone-anvils give more uniform and better road metal.

While stone breaking by machinery is a great deal cheaper, the road metal thus produced does not come up in quality to the hand broken one. Of course, the use of steam stone breakers is only justified where this machinery can be kept constantly at work, and where the cost of transportation from the quarries to the stone breakers is small. For extensive operations stone breakers are always employed, but the breaking of small quantities of rock furnished by insignificant, isolated qnarries is better done by hand.

A complete stone-crushing plant consists of an engine moving a breaker which crushes the stone; an elevator which raises the broken stone to the rotary screen; a rotary screen, which separates the broken stone into three sizes and deposits it in bins, which easily discharge into dump wagons. A rejection spout returns the imperfectly broken stone to the breaker to be recrushed.

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FURNACE-SLAG ROADS.

Recently furnace slag has been employed with great success in place of broken stone for road covering, the modus operandi in building such roads is the same as that just described for broken stone roads. Since common slag is unsuitable for road making on account of its brittleness, it must be specially tempered for such purposes. To this end the slag is run off into pits, there covered with coal or slag hogging, and permitted to cool off slowly in order to become dense and granular upon solidifying. Such slag offers to breaking about the

same resistance as basalt, with which it nearly competes as topping material.

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GRAVEL ROADS.

The thickness of the metaling ought to be increased by one-fourth, or, better still, by one-third, if gravel and coarse sand are the only road materials at hand. Such roads can be built with a foundation layer of large gravel or cobbles, or of uniform and finer gravel. It is advisable to construct such roads in two layers, and to roll each of them by itself. The use of border stones is desirable with gravel roads, although it is often omitted. The characteristic difference between these roads and broken-stone roads lies in that gravel roads contain a road metal somewhat rounded off, which, on that account, cannot in itself form a well-compacted coherent cover.

A cementing material for filling the interstices is therefore needed, that is, something of the character of a binding material. Such is usually found in the required quantity with pit gravel, but washed river gravel, which, when loosely dumped, contains from 40 to 45 per cent. of voids, needs an addition of sufficient loam. To secure a good mixture it is well to spread the loam uniformly over the gravel layer in situ, and to treat the whole with rakes or harrows. To assist toward a better breaking up of the loam, it is desirable to let it lie in the air for some time, and, if possible, to let frost act upon it.

The resistance of gravel roads depends upon the resistance of their binding material. During dry weather it is very pleasant to drive upon gravel roads, but during continued wet weather they begin to soften. Gravel roads always require careful maintenance to secure a speedy shedding of the storm water and to assure a filling in of eventually formed ruts. The construction of gravel roads is customary in districts in which gravel abounds and other stones are scarce. Gravel roads are particularly recommendable in localities in which little rain falls, or where only light traffic takes place during the summer and little of it during the winter season.

In a recorded aggregate length of 14,310 miles of California country roadways we find 2,287 miles of gravel roads, or about 16 per cent. of the total amount.

EARTH ROADS.

About 75½ per cent. of the country roads in California belong to this class. Their extraordinary widths necessitate particular care as to proper drainage, without which the loamy reaches of our roadways soon turn into quagmires during the rainy season. It is well to observe here that with wet or clayey roadways surface drainage alone is not sufficient. Without under-drainage the crown of such roadways will only dry by the slow process of evaporation, during which time the topping becomes more and more rutted by the passing traffic.

A sub-drain in such soils will not prove efficient for more than about 12 feet on each side. Hence two lines of longitudinal sub-drains are needed on those parts of our California country roads that pass through wet places, low-lying lands or clayey soils.

As said before, unglazed round tiles, about 3 inches in diameter, and, under certain conditions, jointed with loose collars are most suitable for sub-drains. The bottom of the tiles should be laid both to the proper grade and below the frost line, after which the tile trench is filled up to sub-grade with clean gravel, small field-stones, road-metal or broken bricks. The cross drains are also made of unglazed tiles, with the exception of their outlet sections, which should consist of vitrified culvert pipes. Regular branch pipes should connect the longitudinal and cross tiles.

On level reaches the lateral roadway slopes for surface drainage should not be less than 1 on 24; and side ditches should be provided, if necessary, as previously indicated. Finally a rapid discharge of the side ditches, if required, through adjacent lands is of the utmost importance to roadway preservation.

Trees should not be allowed on the sides of dirt roads, because they impede the drying actions of the sun and wind. Again, their waterseeking roots are apt to creep into the drains and thus obstruct, if they do not prevent, the function of the tiles.

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No filling should be brought up in layers exceeding 9 inches in depth. During the rolling, sprinkling should be attended to wherever the character of the soil requires such aid.

The cross-section of the roadway must be maintained during the last rolling stage by the addition of earth as needed.

On clay soils, a layer of sand, gravel or ashes spread on the roadway will prevent the sticking of the clay to the roller.

As previously explained, the finishing touches to the road surface should be given by the heaviest rollers at hand.

Before the earth road is opened to the traffic, the side ditches should be cleaned and left with the drain tiling in good working order.

Earth-roads can be improved temporarily, when wet, by layers of brush closely packed and covered with pit gravel.

Since wet sand topping offers less tractive resistance than dry sand, sandy roads should not be drained. Such roads may be improved by a 6-inch layer of good clay. A topping of dry reed or marsh grass, etc. improves the surface of sandy roads, and maintains this condition for some time. About 4.7 per cent. of roadways in California are sand roads.

On clayey roadways, a layer of sand acts beneficially, and all dirt-roads are greatly improved by road metal, furnace slag or gravel coatings.

Earth-roads are readily repaired by a judicious use of road machines and road rollers.

Ploughs and scoop scrapers should not be used for this purpose.

These repairs should be attended to particularly in the spring of the year, and whenever the roadway becomes rutted subsequently. It is best to commence by lightly scraping at the side ditches, and operating towards the middle of the roadway; following the work up and finishing it with the heaviest road rollers. Holes which are not thusly filled, should be leveled up with gravel, hogging or other suitable material, and then, well compacted with rollers. If possible, these repairs should be executed during damp weather, or at least, after a good road sprinkling.

The average cost of the better California country road is $800 per mile; the price varying between $400 and $2,000.

TEMPORARY ROADS.

On swampy ground where the expedients mentioned above are not sufficient or applicable, a suitable log or corduroy road may answer. To this end notched cross logs are placed upon good and solid stringers that are laid along the road bed laterally. The former are again secured near each end by a longitudinal tie, covering them, and tree-nailed down. The cross logs are covered with brush or marsh hay, which receives a layer of the best dirt available. Less comfortable to drive upon are such roads where all the sticks are laid lengthwise.

Roads built of fascines covered with good earth will last, when kept damp, from two to three years. Of course, these roads can only be built in localities where there is plenty of wood. About three per cent. of roadways in California belong to this class.

ADVANTAGES OF ROLLING ROADS.

Rolled roads are better and more permanent than those which are compacted by traffic. They also suffer less by the loosening effect of frost and thawing. The rolling of broken stones should be done rapidly to prevent the soiling of the road metal by dirt.

Rolling saves a large quantity of broken stone, for if the road metal be compacted by traffic, many of its fragments are crushed or rounded before the metal is firm, in which case it becomes unfit to form a rigid topping. Road metal lost in this way will pay for rolling, for the reason that as much as half of it is often thus spoiled before it becomes consolidated by traffic. Vehicles and draught animals forced to compact loose road metal are much damaged, which loss, it is true, does not directly affect the road-building authorities, but is certainly a serious item when viewed from an economical standpoint. The above also holds good in regard to maintenance and repair of roads done by compacting broken-stone layers by passing traffic.

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HORSE POWER AND STEAM POWER ROLLERS.

1st. The steam rollers, by doing more work, reduce the time required for constructing or repairing roads. The superiority of steam rollers is partly due to the facility with which they are moved forwards and backwards; partly to the absence of the disturbing action upon the road surface by the horses' hoofs in connection with horse road rolling, and partly to the larger weight per inch of roller width.

2nd. Steam rollers certainly work cheaper than horse rollers, when compacting road metal which is not only very hard in character but resisting to rolling.

3rd. Since the steam rollers achieve a more thorough compression of the road covering, steam-rolled roads need less repairs.

4th. The facility with which steam rollers reverse admits of limiting the rolling to a comparatively short length of roadway, which is an important item when repairing roadways of considerable traffic.

5th. Steam rollers work well up to 10 per cent. grades and even more, when horse rollers cease to give satisfactory results.

6th. The more expensive steam roller will only pay fair interests on the capital invested when continually employed. In counties where rolling is needed only on comparatively short stretches which are far apart, the exclusive use of horse rollers proves more economical, because the lower price of horse rollers permits the purchase of a number of them.

7th. The economical use of steam rollers requires a systematic preparation in regard to regular supply of road material.

8th. A disadvantage of most steam rollers when compared with horse rollers consists in that the weight of the steam rollers can neither be much reduced for temporary needs nor considerably increased by additional ballast.

9th. The selection of a crew and the preservation of steam rollers will present some difficulties in practice, for the reason that the former must consist of skillful help, and that the latter necessitates considerable supplies, and in the event of larger damages having been done to the machine, the transportation of steam rollers to distant and well-equipped machine shops.

10th. Special precautions must be taken before the heavy steam rollers can be allowed to pass over bridges. In many cases it will be necessary to decide first whether the bridge be strong enough, or whether additional re-enforcing is necessary, or whether the passing of the steam roller across the bridge had better be given up entirely.

11th. Steam rolling must be dispensed with on road coverings made of a road metal of inferior hardness, that is, on fragments which, although they may not crush, may be likely to deteriorate under the heavy weight of rollers. This also holds good on roads where pipes and other fragile constructive elements are laid close to the surface.

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THE OPERATION OF ROLLING.

At the commencement light roller weight is desirable, therefore the application of unballasted rollers, in order to crowd the loose fragments together; an increase in roller weight not being justified until the layer is somewhat compacted. Commence work therefore with an unballasted horse roller, and gradually raise its weight by means of ballast. With steam rollers, that do not ordinarily allow any increase in weight by ballasting, it is good policy to begin with the

lighter ones, and to finish up with the heaviest, provided a number of them are at disposal; or we may compact with horse rollers first, and finish with steam rollers.

The first rolling is done along the borders of the roadway; it is customary that the rollers move up on one side and return on the other. Each succeeding trip follows in the same direction, so that each spot of the covering is always touched in the same sense. Besides that, each succeeding trip overlaps the edge of the preceding one while covering a strip closer to the middle of the road. When the surface near the border or shoulder of the roadway has commenced to consolidate, and there is therefore little fear of a noticeable give toward these sides, then the rolling in the middle of the roadway may be begun. This method of rolling, beginning at the two sides and ending in the middle, is continually repeated.

The road should be watered if there is want of natural moisture. This can be attended to with water carts. Pumps are also applicable where side ditches convey water. Moisture reduces the movement of the stones, prevents the rounding of the angular fragments and accelerates compacting. Too much moisture, particularly with heavy rollers, causes softening of the foundation. To reduce the expenses of water supply, wet weather is preferable for this work. Rolling has to be suspended when by continued wet weather the subsoil has become so soft as to cause a deformation of the road mass upon rolling over it. After the rolling has so far advanced that the displacement of the stone bed ahead of the roller ceases, then the gaps and irregularities, and eventually the holes caused by the draught animals, are filled with sharp angular fragments. As soon as the topping has consolidated far enough that no further movement is visible upon walking over it, then the hogging or detritus from stone breaking, or specially selected binding material, preferably ferruginous gravel, is spread. This is worked into the bed by sharp brooming executed in a direction across the road. Experience teaches that the binding material should be introduced at the beginning of the last third of the total time needed for rolling.

The spreading and brooming of the binding material is continued without interruption to the rolling, until the voids between the fragments of the road covering are filled as much as possible. When this state is reached, and the topping is firm, the rolling is finished. The necessary number of trips over each spot depends upon the character of the road metal, the thickness of the layer, the subsoil,

the weight of the rollers, and the weather. With horse rollers from twenty-five to one hundred trips are required.

With 12½-ton steam rollers and 1½ inches thickness of layer, thirty-three trips over every strip of pavement were needed, and with 4½ inches thickness of layer 143 trips over every point of topping were required. Again, with 2½ inches thickness of triassic limestone as road metal, thrirty-three trips, and with basalt, one hundred and ten trips ; weight of steam roller in this case 13½ tons.

A light steam roller will compact from 140 to 170 cubic feet, and a horse roller from 106 to 140 cubic feet per hour of road metal of average hardness and spread in layers of usual thickness.

It is well to regulate the traffic over new roads rolled with light rollers. This is accomplished by means of barriers that partially blockade the road, and gradually expose all points of the topping to the traffic, thusly preventing the cutting of ruts while assisting in systematically compacting the roadway. Finally it is very useful to roll new roads again, even if only a few times, shortly after they are opened to traffic. This is particularly desirable after the first thawing out of the new road.

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REMOVAL OF MUD FROM ROADS.

Another important labor for the preservation of broken-stone, gravel and dirt roads is the cleaning from mud, which process assists in preventing the penetration of moisture into the roadbed, and aids in drying the road by better exposure to sun and wind.

The removal of sticky mud is effected by means of mud scrapers, and of the more fluid mass by means of brooms. The mud is generally drawn off to the side, and when sufficiently hardened is piled up. Portions of this material may be used for repairing slopes, and the remainder is turned over to adjacent farms as manure, etc. Where such a disposition is not possible the mud must be carted off, which is an expensive operation. Its removal should be repeated whenever needed. Generally it is found sufficient to attend to this class of work twice a year, in the fall and spring ; but in the latter season it must be done in such a manner as to retain a thin layer of mud, which by hardening serves to protect the metaled portion of the road in the summer time. A laborer is able to clean from 700 to 950 square yards of road topping in one day.

Roads having filtering sand foundations require scarcely any cleaning, if their broken-stone coverings produce but little mud. Recently mud-scraping machines have been introduced, of which one of the most popular is Plockhorst's, of Brunswick.* These machines are moved by two horses. They will clean about 9,000 square yards per hour, and cause a saving of over 30 per cent. in cost, even if compared with very cheap hand labor.

GRAVELING BROKEN-STONE ROADS.

The spreading of gravel on roads, particularly after they begin to deteriorate, undoubtedly facilitates traffic. Whether this would also cause a saving in the expense of roadway preservation led Gravenhorst to the following investigations :

On each of four different roadways he selected three experimental reaches, practically level, of which one was not graveled ; one at the usual rate of 35 cubic feet to 44 cubic feet of gravel per 320 feet in length, and 12 feet in width of roadway ; while the third was liberally ballasted with gravel at the rate of 70 to 87 cubic feet. The average of the results of wear on all twelve experimental stretches, after six years of observations, amounted to $\frac{1}{4}$ inch per annum for the ungraveled roadway sections ; for roads graveled at the usual rate $\frac{1}{8}$ inch ; and for roads liberally graveled $\frac{3}{32}$ inch.

These investigations prove the advantage of graveling road coverings, and indicate that it is economically advantageous as long as the cost for gravel does not exceed half the cost of the broken stone supply. Instead of gravel, coarse sand may be used. In very dry sections, and exposed to winds, loamy gravel, or even earthy material, is preferable to clean sand as a cover for roadway topping. The covering with gravel, or with coarse sand respectively, is done on calm and wet days during spring and summer. A laborer can gravel about 1,000 feet of roadway of ordinary width per day.

MAINTENANCE OF BROKEN-STONE ROADS.

Two different systems are employed to maintain the roadway in its original condition. The one, the continuous maintenance by patching, replaces all loss in the original thickness and shape of the roadway caused by wear and tear, in the manner of continuous repairs. For instance, if the road has lost its transverse contour, the deficiency is supplied by filling up the depressions. This filling should be done in two layers, if more than $2\frac{1}{2}$ inches in height are

* The Barnard Castle street scraper is similar in construction.

worn off, the second layer to be spread when the first is compacted by traffic.

Ruts and holes of slight depth in the otherwise perfect topping are filled with gravel or small broken stones. The filling should be done during damp weather. A dry road surface is roughened by picks before the filling is deposited. Material of poor binding qualities used as filling should be rammed down.

This building up by filling should be done in such a manner so as not to induce the vehicles to evade the leveled-up spots, and thus prevent the consolidating of the fresh filling. Filling, therefore, should be done uniformly on all parts of the topping, in order to offer everywhere an equally good surface. Such repairs should not exceed more than 10 feet in length and 6 feet in width at any place. Long ruts, due to neglectful maintenance, should be filled in in short sections, because vehicles might otherwise be disposed to avoid the repaired parts.

This system of repairing, while not excluding the use of rollers in exceptional cases, is very uneconomical in the amount of broken stone required, and is only justifiable under conditions of a plentiful supply. Again, the roadway is seldom entirely smooth and firm under this treatment, and the patching system greatly increases the work of road laborers.

The other system, the periodical maintenance or topping system, permits the wear and tear of the roadway to go on to a certain limit, before entering upon the restoration of the original longitudinal profile and cross section, when all that which was worn off during the course of years is replaced and secured in one layer. This system does not entirely exclude small repairs, but limits them to the timely filling in of holes and ruts in order to check more extensive damages to the roadway. The surface is kept smooth in this manner until its advancing wear necessitates a new topping.

Before the road metal is spread there should be cut along the borders of the road shallow wedge-shaped trenches, having their vertical faces exteriorly. The new metal is then spread upon the bed in the required thickness, and finds its abutments in the vertical faces of these trenches. The new metal is spread in such thickness that the repaired section will eventually assume the height of the adjacent topping. Binding material is not used at this stage, because the wheels of passing vehicles supply such from the neighboring road surfaces. After the repaired sections become compacted, however, the spreading of hogging or gravel to some extent

is advisable. Road rollers should be used wherever a considerable amount of road metal is employed in such repairs, say more than 3 cubic yards of broken stone per 1,200 square yards of road surface.

The question, whether a roadway should be retopped or not is best solved by opening it at several points in order to establish without doubt its true thickness. Experience teaches that the maintenance of a roadway is reduced to a minimum if it is always kept clean, firm and well side-sloped. Where the wear is more particularly confined to the middle of wide roads it is customary to repair this part by itself by a coating of about 15 feet in width. A wear of more than 4 inches should never be permitted, for the reason that heavy layers are very difficult to roll.

The retopping of roads should be done systematically. If, for instance, the permissible wear on a long roadway amount to 3 inches, and the yearly loss by wear is ⅓ of an inch in thickness, then a new coating of 3 inches is required every nine years. Hence we repair the ninth part of the total length of the roadway in consideration every year. It is not to be understood that we are always to continue the retopping where we left off the last year, on the contrary, we should pick out for repairs the worst sections first.

The broken stone used for small repairs should be of a somewhat finer structure than that employed for the new topping. If there be danger that upon rolling the new road metal will move out of place, owing to the particular smoothness and firmness of the roadway, then a roughening by picks of the entire surface, or grooving across the roadway, say every yard, is customary. To facilitate the roughening of the old topping, the better class of steam roller is provided with holes for the insertion of strong iron spurs, which, when passing over the roadway, tear it up by shoving aside the fragments. Mothiron has constructed a special apparatus for this purpose, the application of which reduces the cost of grooving very considerably when compared with hand labor.

The retopping of roadways should be carried out at once over the whole width, wherever possible without too great an inconvenience to the traffic. Deep holes and ruts are repaired previous to the spreading of the material for the new layer. The best time to execute this work is during damp weather. In the dry season sprinkling is required. This topping system in connection with road rolling is preferable on such highways, which require large quantities of road metal in repairing. It is advantageous to exclude, in this event, the use of cheap and poor road metal for the

better material, even if much more expensive. The employment of limestone for resurfacing roadways of important traffic is disappearing more and more on that account.

SPRINKLING ROADS.

The amount of water allowed for each sprinkling to keep California roads from becoming dusty during the dry season, should not be less than 270 gallons per 1,000 square yards, which quantity applied three times a day would give 810 gallons of water per 1,000 square yards of road surface. Fine sprinklers, and frequent application thereof, in moderation, is preferable to the more rare flooding process, both on account of road preservation and for the comfort of travel.

OVERSEERS AND ROAD LABORERS ON EUROPEAN HIGHWAYS.

It is necessarily indispensable to bring up a schooled and reliable corps of roadway labor. Some administrations permanently employ the most necessary number of men, others temporarily engage competent settlers as sub-contractors on agreement. With the customary periodical roadway repairs—the system of periodical road-topping—a permanent road laborer for every three to five miles of broken stone or graveled highways is sufficient. The reaches to be attended to by one permanent laborer are, of course, shorter where the patch system is adopted, a mile and a half of metaled roadway being a fair average length. With dirt roads, the men connected with the road machine, sprinkling cart, and road roller, replace these local laborers.

The immediate superior of the road laborers is the road overseer. He receives a yearly salary, including reimbursement of official traveling expenses and stationery, and is furnished — this may be amusing to you — with a safety velocipede. Although this proposition might arouse your risibility for a moment, when picturing to you a certain class of road men mounted on bicycles, still there are undeniable merits in it. If the overseer is obliged to inspect his district while riding on a velocipede, he will, by his own sufferings, readily find the bad places he might otherwise overlook, and thus become personally interested to a high degree in the perfection of the roadway in his district. The proportion of one overseer to twelve permanent laborers is found in good organizations.

The method of employing labor on our highways will depend upon the locality and surrounding circumstances. Very much more can be done with organized labor under competent direction, than with the hap-hazard system in vogue. Road-making is an art, and it requires men trained to the work to accomplish lasting results.

The present hard times place us in the position to give employment on the roadways to the idle and deserving, and receiving in return a good day's work at moderate expense.

ADAM SMITH.

There is the authority of the gifted Thomas Buckle for claiming that the writings of no other man have exercised so much influence over the [illegible]inies of English-speaking people as those of Dr. Adam Smith, p[illegible]ed 117 years ago. Of course such an assumption must be a matter of opinion, but any fair-minded person, who will read the *Wealth of Nations*, and consider the events that followed its publication, is forced to the conclusion that, with a few exceptions, the whole of our modern political economy, as taught and believed by learned men, is there set forth in a more perspicuous manner than it has ever been presented since, or is likely to be again, because the subject will never again be so impartially considered.

For this great service to the English-speaking people there has not been even the poor compensation or acknowledgment of a monument, or scarcely a portrait that one can believe. He lies buried behind the old Tolbooth, in Edinburgh, under a rough stone that can be found only after some search. We once made such search, and confess to this being the only shrine ever visited that called up feelings of awe and reverential regard for the departed powers and qualities of a man. Here rested in this humble way the ashes of one who thought and reasoned a century and more before his time; whose logical conclusions, laboriously worked out, and completed in 1776, are just now, as we may say, progressing toward some measure of popular understanding among his own and kindred people.

We had been for some months at work, with insufficient ability and time, trying to prepare a synopsis of the *Wealth of Nations*, or, to be more exact, had been experimenting in that way, and, while full of the spirit of this wonderful book, went to Edinburgh, and asked where a portrait of Adam Smith could be seen? No one could

tell. There was no such thing in the public galleries, and as before said, it required a considerable search to find his obscure resting place behind the old Tolbooth.

The fiscal policy of England that has raised her to the foremost place among commercial nations, and to be a creditor of nearly all other countries, and has put more than one fifth of the world under her sway, was the light derived from Adam Smith's *Wealth of Nations*. This conclusion will be arrived at by any one who will impartially follow the history of fifty years from the appearance of the book. It required that time to, in any complete degree, apply practically the laws of trade and commerce there laid down, and at once accepted by those learned enough to understand and study the philosophy taught by Adam Smith.

It is true that political economists of our day sometimes criticize and question the conclusions of Adam Smith, and well may after a century of such change as the past one has been, but the fact is that little has since been done but to clothe in other words, commonly less perspicuous and clear, the principles laid down by the great master.

Adam Smith was born at Kirkaldy, in Fifeshire, Scotland, in June 1723. His father was a customs officer, and was secretary for a time to the Earl of Loudon. Young Smith was educated first in a private school, then in the University of Glasgow, and from there went to Oxford for a term of seven years. He was noted there for a quiet, thoughtful manner, and habits that indicated his great powers of mind.

Upon leaving Oxford he devoted several years to private study, and then delivered in Edinburgh a course of lectures on Rhetoric and Belles Letters; next was appointed to the Professorship of Logic in the University of Glasgow. He was some years later advanced to the Chair of Moral Philosophy, and remained there thirteen years. About this time was published his first great work, *The Theory of Moral Sentiments*, a standard work of great profundity.

Throughout all these studies, for a period of twenty years or more, Adam Smith had been investigating the phenomena of human actions, and now at ripe middle life he was ready to go out into the world and investigate the practical affairs of material life and the application of his theories to common business.

Such an opportunity offered by the Duke of Buccleugh inviting Adam Smith to accompany him for a tour on the continent of Europe,

which lasted several years. At the time of his leaving the University of Glasgow for this journey he had nearly finished his course of lectures for the season, but he called the classes together and returned to each the fee that had been paid for the lectures. The students protested and attempted to run away, but this he would not permit, and insisted on each taking back in full the fee for the term. "It is a matter of conscience with me," he said.

On his return to England he went to the old home in Kirkaldy where his mother remained, and for ten years thereafter was lost to the world. No one it seems knew what he was engaged at, and he seldom left the old town. Once or twice he had to journey to London to consult statistics and authorities there, as afterward appeared. This retirement ended in 1776, when the secret of his labors appeared in the *Inquiry into the Wealth of Nations.* We will give a single quotation here that, as a fragment, will convey an idea of the style in which the book is written.

"Labor was the first price, the original purchase money that was paid for all things. It was not by gold or by silver, but by labor, that all the wealth of the world was originally purchased; and the mode by which the labor of man can be rendered most productive to his use and happiness is the problem to be solved by the economist.

Now the great cause of the increase in the productive powers of labor is found to consist in the *division* of labor — a division which arises in the first instance from the obvious suggestions of nature, and which, by giving birth in its progress to the institution of the various arts, trades and professions which exist in every advanced state of society, occasions that universal opulence which extends itself to the lowest ranks of the people.

But the effects of this principle have never in any society, or in any age of the world, been seen in their full extent, owing to the unjust and impolitic regulations which governments and legislators have at various times devised to control and thwart its operation. Instead of allowing every man to pursue his own interest in his own way, no society has ever yet been seen in which from false views of policy, or from worse motives, extraordinary restraints have not been laid upon some branches of industry; while extraordinary privileges, equally injurious in their result, have been bestowed upon others."

This was, as we may say, the first dissertation on the relations of labor to wealth. No such philosophy had ever appeared in our language, although in the Latin countries some progress had been made in the same line of investigation.

Our suggestion is, especially to those who search after truth, to always refer to the *Wealth of Nations* any proposition in finance,

commerce or industry that may arise, and see if the light there given does not go further in logical explanation than any other authority that can be appealed to. There is the mistake of including profits among the elements of production, as has been pointed out by later writers on this subject.

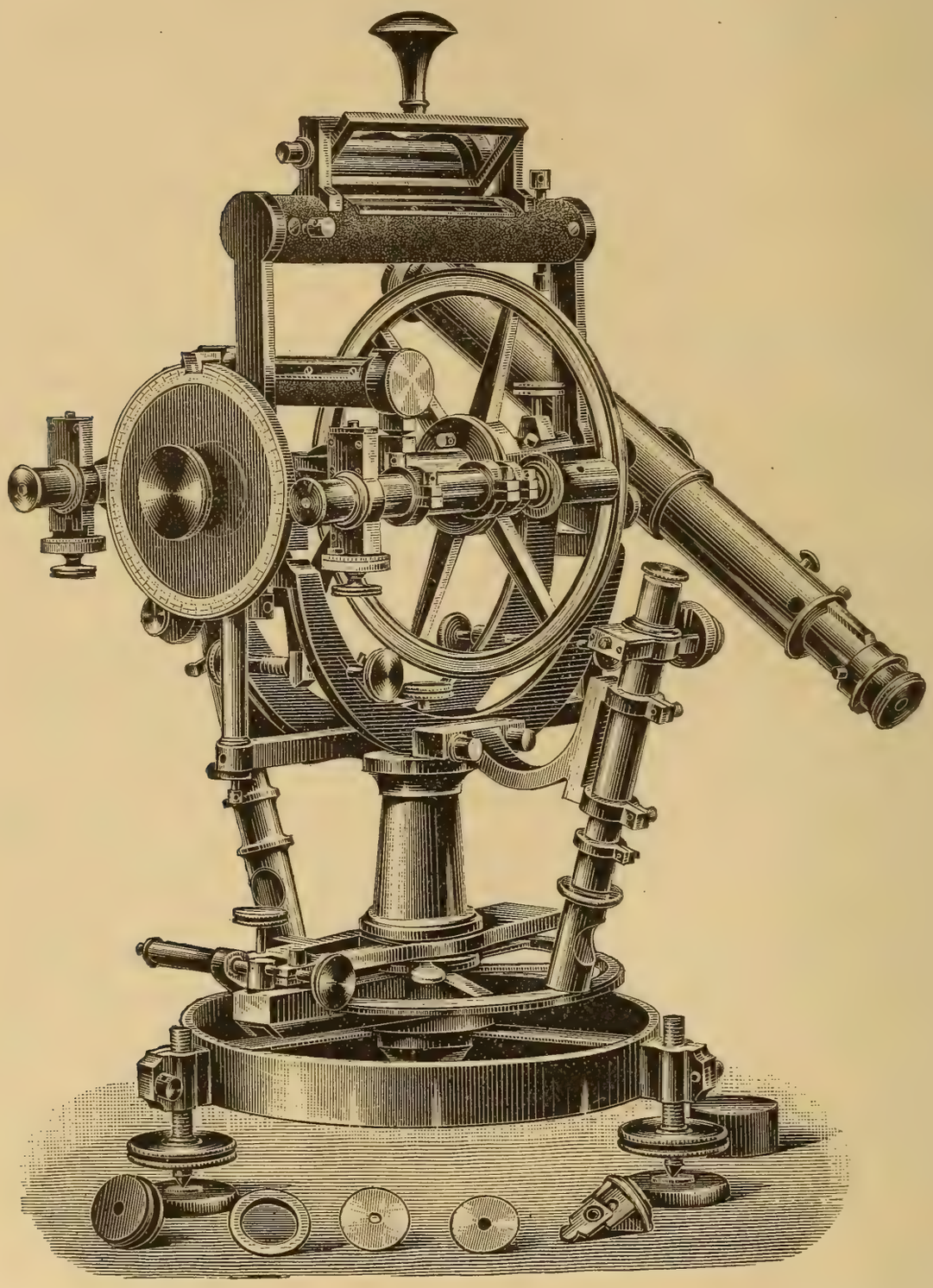
ALT-AZIMUTH INSTRUMENT.

THE A. LIETZ CO., SAN FRANCISCO.

An alt-azimuth instrument is designed for geodetic work, and admits of very accurate determinations of angles in a vertical as well as in a horizontal plane. It finds a universal application in precise surveys, such as triangulation for determining the location of points in reference to a known azimuth and to the horizon.

The surveyor's theodolite will allow an operation of the same character, but its precision, particularly in measurements in the vertical plane will not approach that of the alt-azimuth instrument any more than the scale of the draughtsman could approach the accuracy of the linear dividing engine. Observations may be made with it for latitude and azimuth, and it may be employed for observing the meridian transit of a celestial object.

All these duties call for instrumental requirements of a very high order. The minuteness and accuracy with which the graduated circles may be read, establishes the value of the instrument, for it is from measurements of arcs within very small limits of error, that deductions are made that ultimately lead to the determination of geodetic values with a high degree of precision. It is necessary, therefore, that the observer be able to read very minute divisions of the graduated circles, smaller than the ordinary magnifying glass could discern on the vernier of a plate. The better transits read to 30 seconds, and a fine theodolite may read to 10 seconds, in which case their circles are usually divided into 20-minute or 10-minute divisions. But in the alt-azimuth we must read very much closer, and in order to be able to do so, micrometer-microscopes are attached and set over the verniers, which by means of strong optical powers, together with a mechanical contrivance consisting of a very fine and accurately threaded screw, which has a comparatively large head graduated on its circumference, may enable the observer to read a vernier as close as single seconds of arc. The plates in that case are



ALT-AZIMUTH INSTRUMENT.—THE A. LIETZ CO., S. F.

divided as fine as 5 minutes for each line, which means that a dividing engine must space such a circumference accurately into 4320 equal parts.

The instrument shown in the engraving is an alt-azimuth of the style introduced by Pistor & Martin, a firm of world wide reputation in the manufacture of instruments of precision, and is taken from the list recently published in the "Manual of Modern Surveying Instruments" by the A. Lietz Company, of San Francisco, who have supplied the opposite engraving and this descriptive matter.

The telescope in this particular instrument is attached to the end of the horizontal axis, and is free to swing in a vertical plane. The telescope has a focal length of 13 inches, an aperture of 1½ inches, and a power of 36. The graduated circles are 7 inches in diameter. Double micrometer-microscopes are supplied to each circle reading directly to 5 seconds.

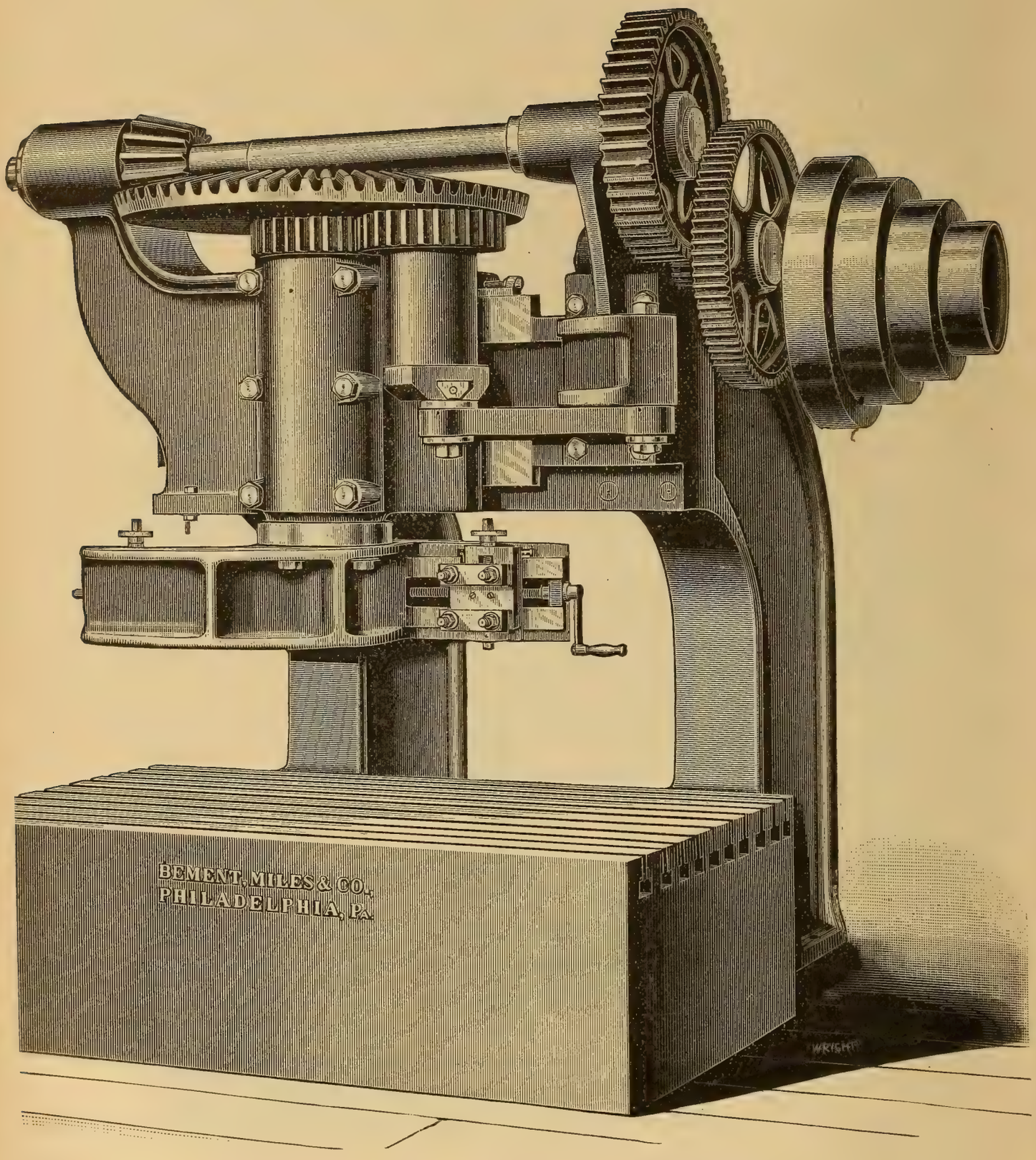
In a 7-inch circle the circumference measures 22 inches, and a space of 5 seconds of arc on this corresponds to $\frac{1}{12000}$ of an inch nearly. This very small division must be measurable with precision, which shows the demands made upon the instrument and the refinement of which it is capable. By a number of continuous repetitions of the angle, we are able to deduce a mathematical mean, correct within very small limits of error.

With repeating instruments of the highest character, the U. S. Coast and Geodetic Survey prescribes that the probable error of any angle in the secondary triangulation should not exceed 0″.7 or 0″.8.

The instrument shown rests upon a firm support and is delicately leveled by three foot-screws. In its construction the aim has been to give it absolute rigidity, so that all the delicate parts may be manipulated without disturbing the refined adjustments of position.

It is not often that in practical and every-day-work our engineers are required to use an instrument of this character. The ordinary transit and theodolite supply all the wants of the professional man in his usual practice. In geodetic determinations, however, that take into account the curvature of the earth's surface, generally undertaken by the State or National Government or by institutions of learning, these instruments belong to the ordinary outfit and play a very prominent part in the labors of the scientific surveyor.

The Lietz "Manual" contains a number of these instruments of different styles and sizes, from the most complete to the most simple, varying in price from 1400 to 450 dollars. The one shown in the engraving is valued at 700 dollars.



ELLIPTICAL MAN-HOLE CUTTING MACHINE.

BEMENT, MILES & CO., PHILADELPHIA, PA.

ELLIPTICAL MAN-HOLE CUTTING MACHINE.

BEMENT, MILES & CO., PHILADELPHIA.

We published in the last volume of INDUSTRY a drawing and description of an elliptical cutting or boring machine for man holes, by Messrs. Harvey & Co., of Glasgow, Scotland, and now have the pleasure of illustrating a machine for similar work by Messrs. Bement, Miles & Co., of Philadelphia.

There has been a good deal written, and a good deal is known, respecting types of machine tools made in this country and in England, and it is singular that in this case we have a transposition of types. The British machine being American and the American one British, by the standards commonly set up for comparison. What we mean is that the present machine is more plain, massive and simple in construction than the one before illustrated. There is no waste of metal, every pound is active in the resistance of strains, and not an element or piece that is not essential.

To form a fair opinion respecting the design of machine tools one must take into account the nature of their intended use, and the hands into which they fall in a works. Here is a machine for cutting out man holes in boiler or other plates. It is a boiler shop or plate-work machine, that must operate in conjunction with bending, punching, edging and other tools for coarse work, one that will be handled by men comparatively unskilled in the use of "finishing" machine tools. The machine is made accordingly of superior strength, the adjustments easy and obvious, and nothing left to be found out, or any part that can be broken by misuse, except the tool points.

The machine consists, as may be seen, of a double-arm cutting head to operate one or two tools, one for elliptical holes and two for circular holes, with a stiff spindle driven by a simple train of reducing gearing. The main spindle is mounted on a sliding saddle that has a short transversing movement equal to the difference between the major and minor axes of the ellipse to be cut.

Alongside of the main spindle is a short one driven at the same rate by spur wheels. On the lower end of this second spindle is an adjustable crank linked to a stationary pin on the main frame, so the main saddle is given a positive reciprocating motion in exact relation to the rotation of the main spindle and cutters. When the crank is moved central or neutral, the link holds the saddle still and

circular holes are cut; when set eccentrically an ellipse is cut. A scale on the sliding crank-pin bar shows the amount of variation in the ordinates of the ellipse, so there is nothing to do but to fasten the plate, set the tools and start the machine. The strong bracket on the left is attached to, and integral with, the saddle and spindle; the cross shaft at the top sliding in the upper or main spur wheel to the right.

The machine will cut holes from 9 to 48 inches diameter, and with a variation of 12 inches or less in the long and short axes of an ellipse. Considering its uses and adaptation we think the design is one of the best that can be referred to in recent machine-tool practice. An "ingenious" designer could find room here for a score more pieces of one kind or another, also bewildering feeds and adjustments.

THE GOEBEL ELECTRIC LAMP.

The disposal of the U. S. Courts of the invention of Heinrich Goebel in incandescent lamps, while it may be fair equity, is questionable law as the statute is commonly construed. That he invented, in 1872 or 1873, an incandescent electric lamp having the essential elements and functions of an Edison one is scarcely to be questioned if the evidence in the case of the Edison Electric Light Company *vs.* the Beacon Vacuum Pump Company was true, but there remains the fact, and it is a great fact, that no one ever profited by, or derived any advantage from, the invention of Goebel, and it would be scant justice now to confer on Goebel the advantage of the labors of Mr. Edison, who invented and applied in the most extensive and advantageous way the incandescent method of lighting.

In a recent trial in the U. S. Circuit Court, eastern district of Wisconsin, Judge Seamans, in a decision involving the Goebel invention, is thus reported:

"In handing down this decision Judge Seamans rejects the claims of Henry Goebel to be the inventor of the incandescent lamp antedating Edison. He carefully reviews the entire course of litigation since the first decision was rendered sustaining Edison's claims. He refuses to accept the testimony of the witnesses for the Goebel side, for 'speaking of such delicate structures, seen by them many years ago, (the testimony) cannot justly be accepted as absolute verity,' and goes on to set forth the doubts raised.

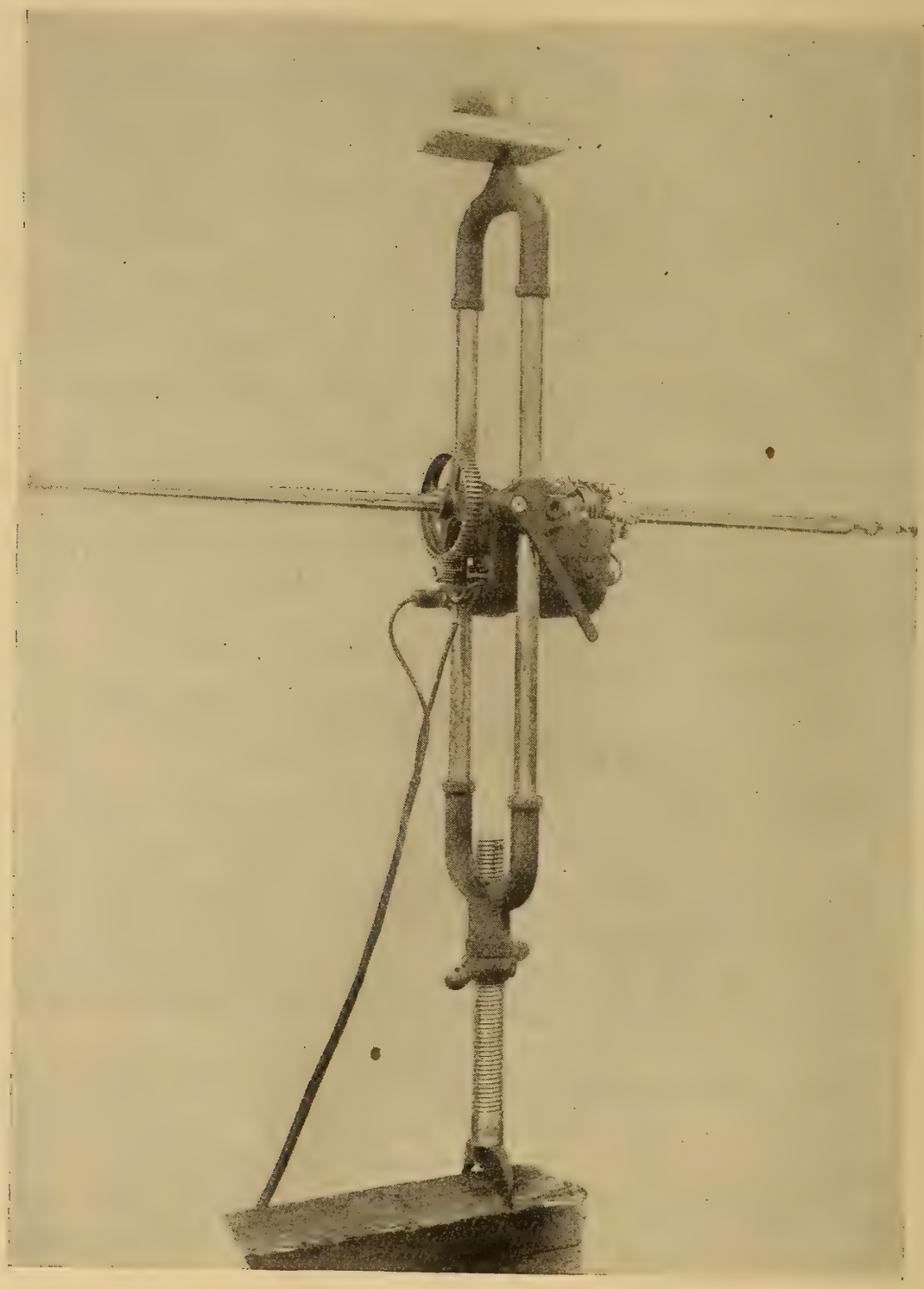
They briefly declare: (1) Goebel never used a filament such as Edison used. (2) Goebel could not have obtained the necessary

high degree of vacuum for the proper operation of an incandescent lamp by the methods he claims to have employed. (3) The alleged constant practice is discredited. (4) Had Goebel invented the lamp he would have patented it, as he was not ignorant of patent practice. (5) The operation of various lamps claimed to have been made so long ago, and their manufacture, are not made clear to the Court. (6) The inability of Goebel to produce a lamp, when such a production would have been most vital. Stress is laid upon the affidavits of the Edison Company tending to show peculiar practice in the manufacture of the opposing evidence. The injunction is granted with 'leave to the Oconto Company to move for the requirement of a bond by complainants to indemnify them for damages they suffer if it shall be finally held that the patent is invalid.' This injunction will probably be appealed from."

Goebel claims that he had been working at this problem since 1854. He is a German, educated in Hanover. He came to New York about 1848, and established an instrument and optical business there, and among other things of an experimental nature he made an electric lamp with a filament arranged inside of an exhausted glass vessel, in what he called the fiddle-bow form, the filament being strung like the hair on a fiddle bow. The exhausted glass vessels were in one piece with pointed ends, the leading-in wires being fused in. He also made what he called the hair-pin filament, bent in the form of that implement, and in form much like carbons of the present time.

Carbons or filaments were made from flax reeds and black cane, one hundredth of an inch in diameter. These lamps Mr. Goebel publicly exhibited at the Cooper Institute, and at Union Square, New York, and the circumstance is altogether remarkable in the fact that the Goebel lamps made no sign until this late day, or at least no sign such as would be expected during the enormous manufacture of filament lamps in this country.

These facts having been set up in the courts, and argued by able counsel on both sides, leading to decisions in several cases in favor of the Edison patents; also the further fact the Goebel invention was cited and considered in the Sayer-Mann suits of 1885, there is certainly good and sufficient reason for denying the anticipation of Mr. Edison's invention.



ELECTRIC ROCK AND COAL DRILLING MACHINE.

THE GENERAL ELECTRIC COMPANY.

ELECTRIC ROCK AND COAL DRILLING MACHINE.

THE GENERAL ELECTRIC CO.

Whatever may be the result of producing direct reciprocating movement by means of solenoids, or other electrical apparatus, there can be no doubt of successful application wherever rotary motion is available.

The example above shows the compactness and portability of rotary electro-motive apparatus powerful enough to operate mining drills or augers, also the adaptability in every way to that purpose. The plate shows a very complete design for portable drilling or boring machines, of which the company send the following particulars in respect to construction :

"The types are made, one for heavy work in anthracite, or drilling in hard slate or 'boney;' the other for lighter anthracite drilling and for bituminous coal. The drills are interchangeable in their mountings, the same post taking either. The control of the motor is affected by a small plug switch. Feed screws of different pitch are furnished for varying the speed of boring, and a friction clutch protects the motor should any particularly hard obstacles be struck suddenly.

The columns are made in different lengths, and each is adjustable for about two feet variation. The construction of the drill, and its method of mounting, enable the operator to drill close to the roof, floors or walls as well as in any direction as above noted."

Following this are the facts of some tests made in coal mines in Pennsylvania that are marvelous. We cannot spare space to publish the tabulated results, and, we may add, it is quite useless, because the speed of penetration in making blasting holes is such that the "time" is an inconsiderable quantity. The rate in anthracite coal was nearly eight feet per minute. In hard "boney" rock the rate was thirty to forty inches per minute, so that moving and adjustment are the main parts, the boring to be incidental, so to call it.

It is an ideal machine of exceeding simplicity, and capable of rapid adjustment, because light and not requiring the weight and inertia indispensable in reciprocating drilling machinery. This feature enables rapid and easy setting and adjustment, so that making blasting holes is, perhaps, reduced to its lowest possible limits.



CAPTAIN M. A. HEALY.

We are indebted to the *Mechanical News* for the above portrait of Commander Healy, of the U. S. Revenue Steamer *Bear*, so familiar in these waters. Captain Healy is well known here among a circle of influential friends, and, while a seaman all his life, he has also been an observer of many scientific and economic matters of national importance.

He has, in his extensive service in the high latitudes, observed and reported upon the relation that the reindeer bears to the Indian tribes of the frozen regions, and endeavored to secure Congressional aid in introducing these useful animals in Alaska. Failing in this he has, by his personal efforts and expense, succeeded in planting a colony of 200 reindeer there. Captain Healy maintains that the Polar Regions of the north can be reached by the aid of these animals.

Of his connection with the *Bear*, and other public services, the following is reprinted from the *Mechanical News* :

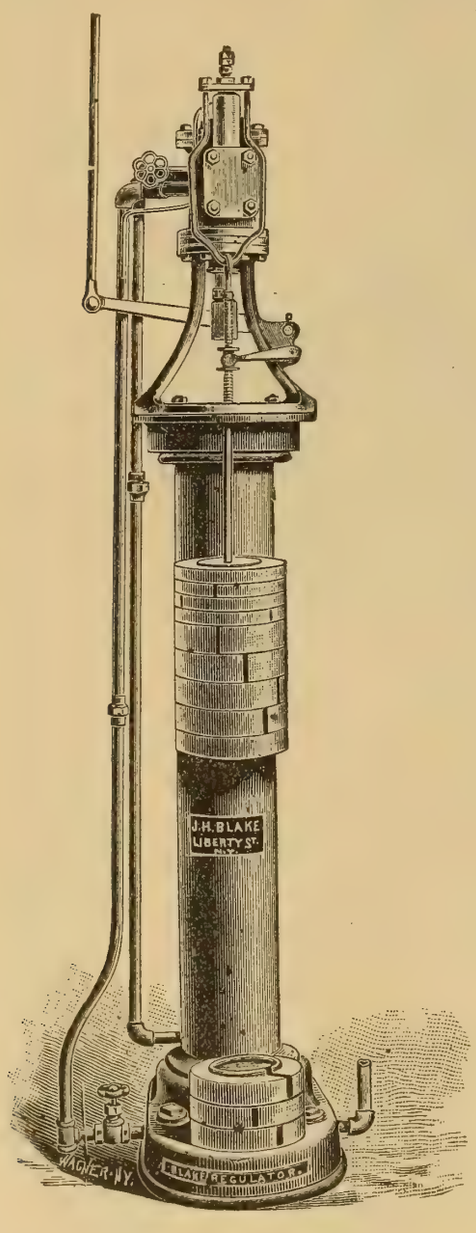
"The *Bear* is not only the most interesting vessel in our navy, but every year she is called upon to perform the most useful and dangerous service. The duties of Captain Healy, who is the only representative of our Government in the Arctic Sea, are as varied as they are difficult. Last year there were fifty-two whalers in the Arctic, of which four were lost. In whalebone alone the fleet brought back over $2,000,000 worth. All these vessels were under the protection of Captain Healy, whose duty it was to see that none of them got caught in the ice pack. Besides this work, the *Bear*, in early summer, is commissioned to cruise about the seal island, and drive off the poachers who are raiding the rookeries. Another important duty performed by the *Bear* is to board and search each vessel entering the Northern Sea. Before the Government was represented in these waters the swindling of the Alaskan Indians was a recognized industry among unscrupulous traders and whalers. Not only were the natives robbed by these rascals, who got valuable furs and ivory for a mere song, but they were fast becoming brutalized by the cheap whiskey which they received in exchange. This enormity has now been almost wiped out, thanks to the *Bear*. Since Captain Healy has been in command of this important mission he and his crew have rescued no less than three hundred shipwrecked sailors, and aided hundreds of sick and destitute miners and others.

Captain Michael A. Healy has been a sailor all his life. During the war he was in Australia, but he hastened back to fight for his country. He was too late, however, to participate in active service. His naval experience, which extended all over the world, secured him the commission of third lieutenant when he entered the service on a revenue cutter in 1865. He rose to second lieutenant in two years, and served in the *Reliance*, at Sitka, until 1869, after taking her around the horn. Then he spent some months on the *Lincoln*. Upon his return he was stationed on the *Rush*. After taking her through the Magellan Straits, he remained some time in her in the Pacific. His experience with the Arctic Ocean began in 1880, when the search was made for the *Jeannette*. He was then second lieutenant of the *Corwin*, which participated in the search, and from that time on he has made annual cruises into the Northern Sea. In 1881 he was made captain, and sent by Congress to make a tour of the Arctic Regions in the *Rush*. It was in the relief expedition sent north after the survivors of the Greely party that the now famous *Bear* became noted for being the finest vessel ever built for the Arctic service. She was then owned by Great Britain. In 1886, when she was presented to this country, and turned over to the Treasury Department, she was put in charge of Captain Healy. How well she has sustained her reputation since then is a matter of history."

HYDRAULIC REGULATOR.

The Risdon Iron Works have supplied on this Coast a number of the regulators such as are shown in the engraving, for operating dampers and controlling the fires of steam furnaces.

The machine is essentially a hydraulic cylinder and piston, controlled by a piston valve, the movements of the latter being governed by pressure of water from a feed pump or steam boiler. The piston valve has a stem projecting out through a gland at the top, the area of this stem being so proportioned that the required pressure will balance the weights seen in front.



If the pressure falls the weights and valve descend, admitting water to the top of the actuating piston, which is connected to and moves the lever seen beneath the cylinder. This lever is connected by tooth segments to a short lever seen in front, so as to give the valve an overtake motion and thus stop the main lever at various points in the arc of its movement in accordance with the variations of pressure. The main lever is connected by the rod or link seen on the left, to a damper, water-wheel valve, gate or other device to be controlled.

The main stand is a reservoir to contain condensed water when the pressure is drawn from a steam boiler, the engine being supplied from the bottom by a pipe seen on the left, the other pipe being a waste or exhaust one for the engine.

The apparatus is in effect the same as a steam or hydraulic steering gear for vessels, except the controlling element is pressure instead of hand movement, that is, the actuating piston follows an adjustable means of "indication," and stops at fixed positions cor-

responding to the range of indication and, in this case, of pressure.

The apparatus is neatly finished, intended to stand in an engine room where the position of the dampers, and state of the fires, are continually shown to the engineer. There are three or more sizes, to exert a force of 200 to 600 pounds as may be required, to exceed all the contingencies of resistance.

This is a tolerably small machine or apparatus for so long a description, but it has some relevancy to our remarks last month respecting "weak regulating apparatus," the inefficiency and failure of which is commonly a want of power to perform the required functions, especially in regulating the speed of water wheels. What is required is sensitive indication, and in addition, an actuating force sufficient to overcome all possible resistance.

THE TECHNICAL SOCIETY OF THE PACIFIC COAST.

The regular meeting of the Technical Society was held at their rooms October 6th, when the following new members were elected :

Edward N. Eager, County Surveyor.....Solano County, Cal.
R. J. Rolfson, Mechanical Engineer.....San Francisco, Cal.
R. M. Vail, Mining Engineer.....San Diego, Cal.
J. S. Walker, Civil Engineer.....Samoa.

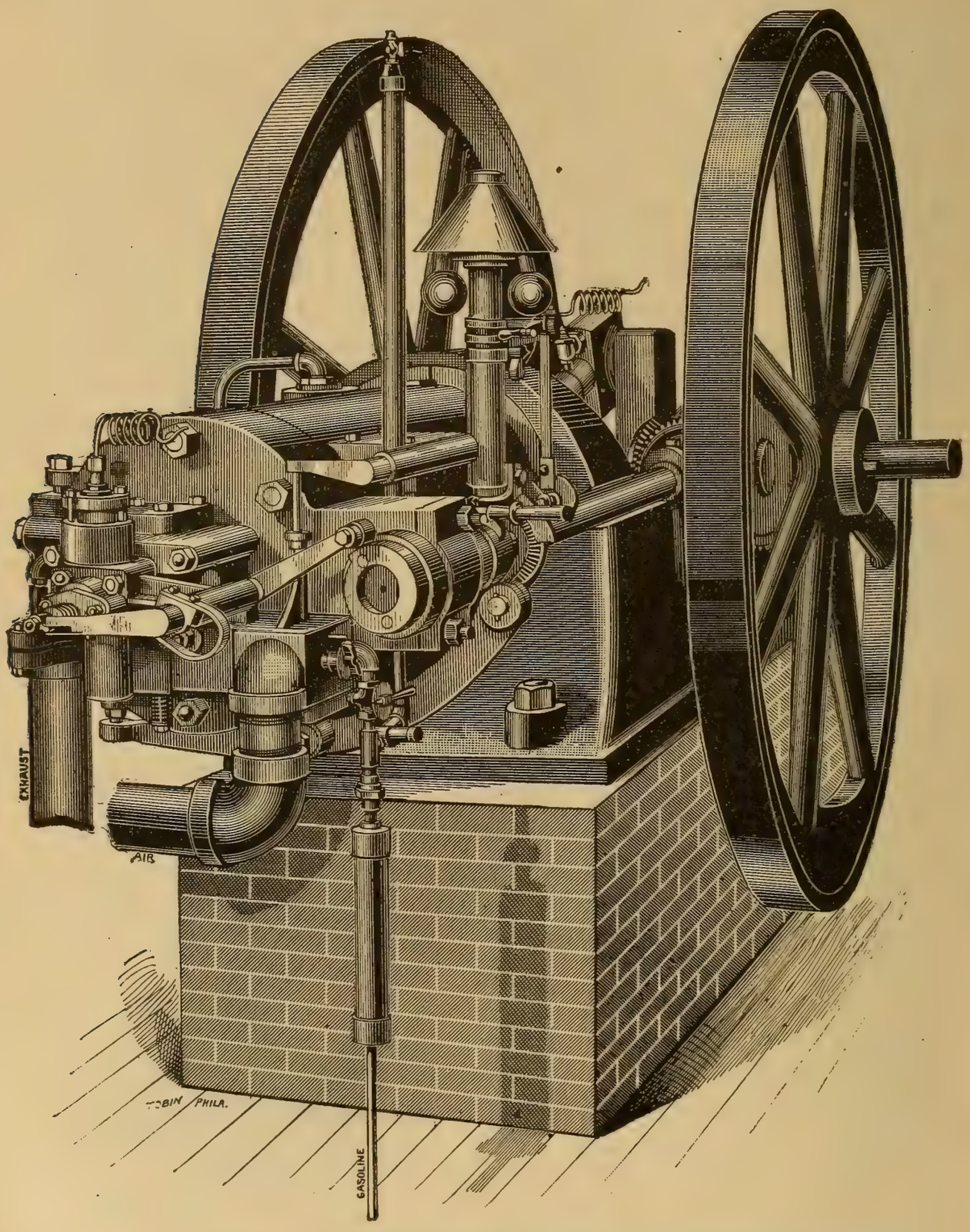
Mr. Luther Wagoner submitted a paper, which was read by title, "On the Duty of the California Wet-Crushing Stamp Mill."

Mr. D. C. Henny delivered an address, with a mathematical treatise, entitled : "Supports Required for Curves in Pressure Pipes." The discussion of this subject was held over for a subsequent meeting, and the paper will be published in full in the next issue of the Transactions.

The delegates to the State Road Convention, held at Sacramento, September 7th, made a verbal report, stating that the members, J. H. Striedinger, O. H. Buckman and Otto von Geldern, had attended the Convention on behalf of the Technical Society, and participated in the discussion there.

Messrs. Striedinger and von Geldern read a paper that had been presented but not read at the Sacramento Convention. Excerpts of this paper are reprinted in our present issue.

At the next meeting, Nov. 3d, there will be discussions of various subjects laid over from previous meetings.



35 Horse Power Otto Gasoline Engine.

SCHLEISCHER, SCHUMM & CO., PHILADELPHIA, PA.

35 HORSE POWER OTTO GASOLINE ENGINE.

SCHLEISCHER, SCHUMM & CO., PHILADELPHIA, PA.

The "internal combustion engines" of Dr. Otto, which came out in their "projectile" form in 1867, have since that time held a permanent and increasing place among motive engines. The gas type were at first arranged so the explosive force of the charges acted to partially expel a heavy weight from a vertical cylinder, the descent of the weight between explosions being utilized for motive power. This projectile system soon gave way to a piston and crank, as the engines are now made. More than forty thousand have been sold by the Otto Works at Deutz, Germany and the branches in England, this country, and elsewhere, working under the Otto patents and designs.

Messrs. Schleischer, Schumm & Co., of Philadelphia, are the representatives and makers of Otto engines in this country, and have a large and finely-equipped works there, where both gas and gasoline engines are made in a very perfect manner. The engraving shows a newly-designed gasoline engine of 35 horse power provided with the latest improvements for engines of that class. These engines are made of various sizes up to sixteen horse power in sections, so as to be taken apart and transported on mules in mountainous places for mining, or other purposes. The consumption of oil is about one tenth of a gallon for each horse power per hour, or less than one cent, where the oil can be obtained at the lowest market rate.

COMMUNICATION.

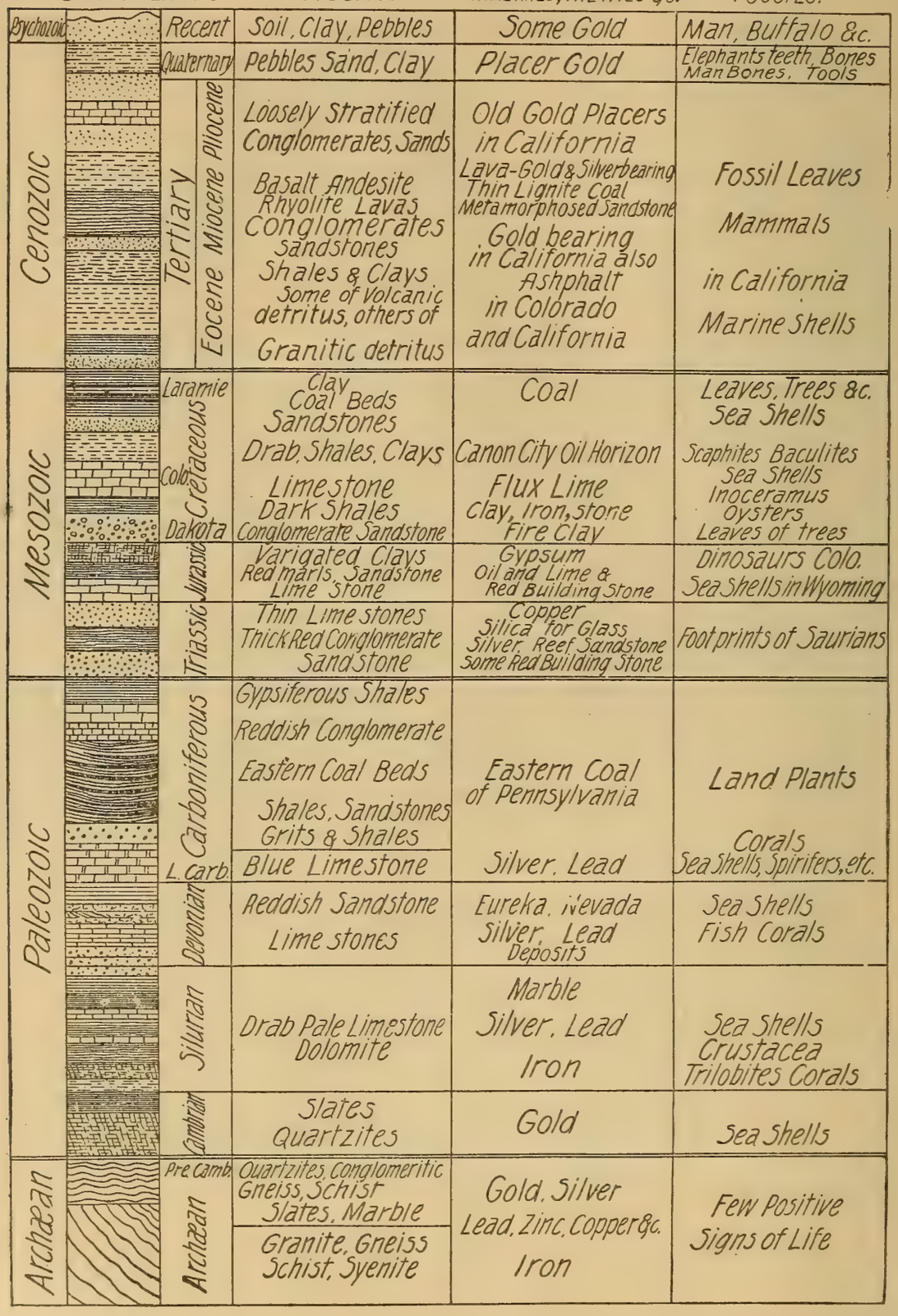
To the Editor of "Industry."

Dear Sir:—In the October issue of Industry, page 700, I notice the following sentence: "It is curious that man's ingenuity has not been sufficient to produce crystallized carbon or diamonds."

In refutation of the above statement I would quote the following from an article by Prince Kropotkin in the *Popular Science Monthly* for September:

"At one of the recent sittings of the French Academy of Sciences, Henri Moissan, whose name has lately been prominent in chemistry in connection with several important discoveries, read a communication to the effect that he had finally succeeded in obtaining in his laboratory minute crystals of diamonds. * * *

Some of the crystal obtained by Moissan are real colorless and



Characteristic		Rocks.	Minerals, Metals &c.	Fossils.
Psychozoic	Recent	Soil, Clay, Pebbles	Some Gold	Man, Buffalo &c.
Cenozoic	Quaternary	Pebbles Sand, Clay	Placer Gold	Elephants teeth, Bones Man Bones, Tools
Cenozoic	Tertiary Pliocene Miocene Eocene	Loosely Stratified Conglomerates, Sands Basalt Andesite Rhyolite Lavas Conglomerates Sandstones Shales & Clays Some of Volcanic detritus, others of Granitic detritus	Old Gold Placers in California Lava-Gold & Silverbearing Thin Lignite Coal Metamorphosed Sandstone Gold bearing in California also Ashphalt in Colorado and California	Fossil Leaves Mammals in California Marine Shells
Mesozoic	Laramie	Clay Coal Beds Sandstones	Coal	Leaves, Trees &c. Sea Shells
Mesozoic	Colo. Cretaceous	Drab Shales, Clays Limestone Dark Shales	Canon City Oil Horizon Flux Lime	Scaphites Baculites Sea Shells Inoceramus Oysters
Mesozoic	Dakota	Conglomerate Sandstone	Clay, Iron, stone Fire Clay	Leaves of trees
Mesozoic	Jurassic	Varigated Clays Red marls, Sandstone Lime Stone	Gypsum Oil and Lime & Red Building Stone	Dinosaurs Colo. Sea Shells in Wyoming
Mesozoic	Triassic	Thin Lime stones Thick Red Conglomerate Sandstone	Copper Silica for Glass Silver, Reef Sandstone some Red Building Stone	Foot prints of Saurians
Paleozoic	Carboniferous	Gypsiferous Shales Reddish Conglomerate Eastern Coal Beds Shales, Sandstones Grits & Shales	Eastern Coal of Pennsylvania	Land Plants Corals
Paleozoic	L. Carb.	Blue Limestone	Silver, Lead	Sea Shells, Spirifers, etc.
Paleozoic	Devonian	Reddish Sandstone Lime stones	Eureka, Nevada Silver, Lead Deposits	Sea Shells Fish Corals
Paleozoic	Silurian	Drab Pale Limestone Dolomite	Marble Silver, Lead Iron	Sea Shells Crustacea Trilobites Corals
Paleozoic	Cambrian	Slates Quartzites	Gold	Sea Shells
Archæan	Pre Camb. Archæan	Quartzites, Conglomeritic Gneiss, Schist Slates, Marble	Gold, Silver Lead, Zinc, Copper &c.	Few Positive Signs of Life
Archæan	Archæan	Granite, Gneiss Schist, Syenite	Iron	

PROSPECTOR'S GEOLOGICAL TABLE OF WESTERN FORMATIONS, SHOWING PRINCIPAL CHARACTERISTIC ROCKS, MINERALS AND FOSSILS TO BE FOUND IN THEM.

crystallized diamonds — the gem we all know and admire. For industry and every-day life the infinitesimal quantities of diamond dust obtained by the French chemist may have no immediate value, and some time will be required before a modest-sized jewel is made in a laboratory."

Following this is a description of the method pursued by Moissan in arriving at the results indicated above.

Yours respectfully,

W. A. GRUBB.

San Francisco, Sept. 29, 1893.

GEOLOGICAL REFERENCE CHART.

Professor A. C. Lake, of the State School of Mines, at Golden, Colorado, has written for the *Colliery Engineer*, Scranton, Pa., a series of very interesting and useful articles on prospecting for gold and silver, and in illustration of the importance of geological knowledge, and also as a useful means of reference, has prepared the chart shown on the opposite page. This chart is one that should be preserved by our readers for reference, showing, as it does, at a glance how this wonderful earth is built up, and the characteristics of the ages and periods lying thousands, and perhaps, millions of years behind us in the mysterious past.

Of the practical value of geology in prospecting we will quote briefly from one of Professor Lake's essays in the *Colliery Engineer*:

"A prospector in his roaming among the rocks is likely, from time to time to come across a good many fossils, or petrified remains of life, that once existed on this planet. He will feel curious to know what these are, what class of animal or vegetable they may represent, to what geological era, epoch or subdivision they may belong.

Fossils to a geologist are the labels of the rocks; show a geologist a fossil, and he will probably be able to tell at glance whether the fossil came from a series of paleozoic, mesozoic or cenozoic rocks, whether it belonged to a very ancient geological period down near the primitive granite, or to a comparatively recent one near the modern soil, high up in the geological scale and nearer to the life of the present day. He may be able to tell not merely whether it belongs to one of the great divisions, to the great eras, but also to the subdivisions of these eras, whether to the silurian or carboniferous, the jurassic or the cretaceous, or even to minor divisions of these, called groups, whether, for example, it belongs to the Dakota group of the cretaceous, or to the Laramie group of the same period.

The practical use of a general knowledge of fossils is obvious. A prospector finds in certain strata a fern leaf of the carboniferous,

this tells him he must be on coal strata, and forthwith he hunts for coal; or he finds a paleozoic shell or coral, which points to the fact that he is probably in the neighborhood of the precious ore-bearing rocks.

Later perhaps he finds a shell or coral, characteristic of the lower carboniferous blue limestone, the celebrated lead-silver bearing formation of Colorado and the West, and he is encouraged to look for these ores. The limestone by itself is but a poor guide, for there are many limestones not unlike it in the different series of rocks, but this particular shell labels this as "the blue limestone" and no other. Hence a characteristic fossil may help considerably in following up in its extension an ore-bearing rock, and not only that locally but in regions very far apart. Soon after the celebrated ore deposits of Aspen were discovered, and the mines were in their infancy, some fossils were discovered that showed the deposits to be in the same limestone as that at Leadville, which had proved there so productive. This gave an additional impetus to the camp, "a second Leadville" so it was said.

Again, though a prospector may not find at once the particular geological stratum or period he is looking for, if he finds a characteristic fossil anywhere, in some other period, he knows from it whether the period he is after lies geologically below or above where he is looking.

Thus, if a prospector finds a silurian shell he knows that the carboniferous "blue limestone" must be close above this silurian, or if he finds a marine cretaceous shell he knows that the Laramie coal-bearing group lies above. On finding a cretaceous or jurassic fossil he knows that the carboniferous and paleozoic series must lie considerably below him.

In the accompanying geological table we have shown what rocks, and what minerals and metals, are likely to be found on the geological divisions and subdivisions, also, generally, what classes of fossil life are to be expected in each.

FOREIGN INVESTMENTS IN AMERICA.

Mr. John P. Young has written for the *Chronicle*, of this City, to show that the present financial depression in this country is caused by the enormous tribute drawn from here by British investments now estimated at two thousand millions of dollars in stock exchange, or listed securities. To this may be added another large amount of unlisted securities, calling the whole $2,500,000,000, the interest or earnings of which must be, and is, paid regularly, amounts at seven per cent. to $175,000,000 a year.

We have for five years past urged the same theory, and predicted that confusion and misfortune would follow such a policy.

We will venture to say that nine tenths of the property and securities thus sold have left the hands of those who noisily condemn in every way the fiscal policy of Great Britain.

Truth will prevail, and if for twenty years more Great Britain can continue her unrestricted commerce among nations that maintain protective tariffs, she will rule the earth in a financial sense and lay the whole world under tribute. Revenue collected in this manner does not reach the treasuries of the nations where it is assessed, but goes into the coffers of British capitalists at London, if not in interest, in the way of profits. Even subsidies paid to citizens and companies are directed to London, as in the case of the Pacific Mail Steamship Company and more notably the French bounties on shipping.

If we subsidize our own people by means of a tariff increase in prices and profits, the subsidy, or tariff becomes a premium on valuation and the owners at once hie away to England to sell the whole business. No blame can be attached to British investors, who importuned by all the artifices known to promotion, place their capital here.

The past twenty years has witnessed a craze to make money. Patriotism or even decent respect for the national welfare have not existed. Those professing most patriotism, are the very people who have acted irrespective of public interests. The brawlers for "Americanism" have been the people who have sacrificed America to their own interests.

The remedy is to assess the national revenue on property and earnings of property, and not on consumption as is now done. Then profits will become normal and more uniform. Stocks could not be watered and there would be no inducement held out to foreign investors for purchasing our railways, factories, and whatever gives promise and assurance of abnormal earnings.

We have been taught by both precept and example the possibilities of our vast resources, but have pursued the narrow policy of a third rate power, afraid to go out into the world and fearlessly compete for our true share of the world's trade and its profits.

All necessary or expedient expansion of our industries could have been attained by means of American capital. Railways could have been made as soon as they are required, and it is a question now whether we are really benefited by our immense railway mileage, saddled as it is, with debt to foreign investors. The railways, many of them, do not belong here at all, except the watered

stock. We have the water and the British have the railways. A first charge equal to fair earnings on most of our lines, goes to pay the interest on bonds held abroad.

The whole system is wrong, born of an unwholesome and irrational craze for expansion that has brought just now, and will bring again financial panics and disorder of all kinds.

The remedy lies in laws that will prevent fictitious valuations for incorporated property, also to remove from such property all the circumstances, such as subsidies and tariffs, that cause and suggest fictitious valuation. In other words, laws that will compel people to come down to "facts" instead of untruth and financial trickery.

WATER-WHEEL GOVERNORS.

At Ottawa, Canada, where the street railways are operated by electricity generated by water power, there has been great difficulty in regulating the speed. The sudden fluctuation of resistance such as occur in street traffic where there are grades, and various other causes to vary the consumption of power, are such that a regulating apparatus applied to the gates of the water wheels did but little good.

The result in this case has been that the governor apparatus was abandoned, and an attendant stationed to watch the wheels and adjust the gates so as to maintain sufficiently regular motion for the dynamos. These are of the Westinghouse type, two of them of 400 horse power each. To operate the gates by power, and quickly, two drums or pulleys are driven in different directions, so arranged that one opens and the other closes the water-wheel gates by means of detachable clutches.

The attendants have before them a voltmeter to see the pressure on the lines, and move or connect the water-controlling gearing accordingly. Two men in charge change every thirty minutes, and it is claimed have no difficulty meeting all emergencies, and maintaining a nearly constant potential on the lines.

This circumstance suggests some comment on water-wheel regulation. It has long been a problem, and is destined, no doubt, to pass through a period of evolution, the same as the regulation of steam engines has done, but in shorter time, because there is a good deal of analogy in the two things, features common to both, and there is now the precedents of steam regulation to guide.

A pressure-turbine wheel must be regulated by changing the

size or area of the chutes or in-charge issues, and as this requires a good deal of power, such power cannot be derived from centrifugal apparatus, or any kind of governing apparatus directly, but must be generated by the wheel itself or by some extraneous power, the governor, what ever it may be, furnishing "indication" only. The power must act instantaneously, and be sufficient to move a circular gate, or a set of chute vanes, that offer a heavy resistance.

For a wheel of the dimensions mentioned in the first part of this article a thrust of one ton at least will be required, and this at a rate of one foot per second, or about four horse power, and with the required gearing, and to meet emergencies, double this force should be provided. As this power acts only at intervals and short ranges its aggregate amounts to but little.

At Ottawa, the men, aside from observation, perform nothing but what is called indication, that is, they connect or disengage something that does not, or need not, call for a force beyond what could be supplied by variations of an electrical current, and we think there is a good case here for inventors.

In our exchanges we find an account and engravings of a new way to join leather and gum machine bands by means of a great patch on the back and screw bolts to hold the patch on, also special implements to be employed in making the joint. It is time these things passed out everywhere as they have here in California, where the joints in bands are butted and laced with copper wire, so the joint can scarcely be found and will stay there while the band lasts. Not only this, there is no obstruction and the bands can be reversed in running over binding pulleys. Theory is that flexure is not interfered with. Whatever stiffens a band adds the element of destruction, but all else aside, the wire-sewed joints are cheaper, neater and in every way superior. We have in mind just now a heavy leather band 48 inches wide transmitting 300 horse power, bending two ways over small drums. This band has not been repaired for two years and no one can detect when the joint passes over iron drums.

LITERATURE.

A Great Catalogue.

Messrs. Bement, Miles & Co., engineers and machine-tool makers of Philadelphia, have issued a sumptuous catalogue illustrating standard types of the machines made at this establishment.

We imagine that no work of the kind has ever before been produced in this or any other country. There are about eighty plates, representing the various tools, printed from wood engravings in the highest style of the art, with paper and binding remarkable in the same degree. The feature, however, that will most appeal to the engineering world is the plain comprehensive specifications that are given in connection with the drawings, things that a purchaser wants to know, and an absence of all factitious "furtherances" that too often encumber such books.

These works, perhaps the foremost in this country in their line, both in character and extent, have concentrated their resources upon machines for metal working, including both hot and cold processes, and the present catalogue represents an accumulation of forty years' experience, all the time observing and drawing upon the practice of the world for the trend and nature of improvements of every kind.

The present, so far as we know, is the first organized collection of the kind issued in press form by the firm, and one will think it is quite enough for a long time to come.

Mr. F. B. Miles is the engineer of the firm, and joined it many years ago by a consolidation of his own works near by, but now an integral part of the immense plant.

Massachusetts Institute of Technology.

This prominent technical college, the largest in the United States, has prepared an illustrated bulletin giving a historical and other account of this institution. The instruction is confined to what may be called the technical branches, including biology, geology and what are termed general studies.

The Institute was opened in Boston in 1865, and the enrolment of members is more than one thousand. The income from invested funds is $25,000 a year, and from fees $185,000, which with other sources of income amounts to an aggregate of more than $250,000 a year.

The libraries contain 26,631 volumes, and there are eight laboratories, all fully equipped with approved apparatus and facilities for research and experiment. There are in all 125 instructors of various ranks.

The present publication contains many fine photographic views of buildings, laboratories and other rooms, and is executed in a tasteful manner. Copies can be obtained from Dr. H. W. Tyler, the Secretary, at Boston.

Books Received.

Continuous Current Dynamos and Motors. By F. P. Cox, B. S. The W. J. Johnson Co., New York.

Dynamo Machinery. By Professor John Hopkinson. The W. J. Johnson Co., New York.

The International Naval Rendezvous and Review of 1893. Office of Naval Intelligence. Washington, D. C.

Triple and Quadruple Expansion Engines and Boilers. By A. R. Leask. The Tower Publishing Co., London. Osborn & Alexander, San Francisco.

Table Book for Civil and Mechanical Engineers. By G. W. Plympton. D. Van Nostrand & Co., New York.

The Religion of Science. By Paul Carms. Open Court Publishing Co., Chicago.

Consular Reports, No. 196. September, 1893. Government Printing Office, Washington.

Twenty Years with the Indicator. By Thos. Pray, Jr. John Wiley & Sons, New York. Osborn & Alexander, San Francisco.

LOCAL NOTES.

The Exhibition to be held in this City during the coming winter seems to be assuming a good deal of extent and importance, and will no doubt be the great event of the year, or of several years, for San Francisco. We have not this far taken any part in discussions of this subject. A technical journal should not deal with exhibitions, but with what is shown at them, and this function will not be neglected when the proper time arrives. The accounts given of exhibits at the Chicago Exposition have, as we believe, been less complete than in former cases when there was less extent and diffusion. The aggregation is large at Chicago, but in a technical way does not include the novelty expected or possible. Practical mechanics, including Professor John E. Sweet, if he can be classed under that head, and Mr. Miller, of the *American Machinist*, have written the best accounts of the exhibition that have appeared in the technical journals. The exposition here will be more within the scope of description and criticism, because not so extensive.

In a journal of this kind, or to be more explicit, in this Journal, the compendious form of our articles and remarks is not choice but necessity, and at the risk of raising doubts let it be explained the difficulty in such writing is to shorten, not lengthen, articles. What people want is ideas, not prosy details. Twenty-five per cent. or more of all that is written for INDUSTRY goes into the waste basket. Five pages are reduced to four, then to three, and not unoften the three are then made into a paragraph. Another difficulty is that for those skilled in technical matters elementary description is tedious, while for the unskilled the same matter is mysterious. How to accommodate such conditions is a problem that Lord Dundreary would define as "something no feller can find out."

The launching of the *Oregon* last month was a portentious achievement for this Coast, and should command admiration as well as all possible moral support for the Union Iron Works, that have on new ground, in a remote part of the world, and a want of many of the aids existent elsewhere, achieved all that is possible in this greatest of modern arts. The particulars of the *Oregon*, and the

circumstances of her construction and launching, have been given over and over again, and our part must be confined to mention of the engineering and business skill that has built up such an industry here. It is hard to realize a creation like the *Oregon* rising out of the mud flats of the Potrero in a growth of seven years, three thousand miles from any parallel venture, and an equal distance from the source of the principal supplies. The "staff" of the works should receive some kind of public expression of the feelings of the people on this Coast in respect to what has been done. The company are a great fact in such agencies as must work out the future of this western country.

As soon as Congress ceases to "fool" with currency, and foreign investors see there are no grounds to apprehend repudiation in this country, there are many useful enterprises here on this Coast that can go on with much gain to the people. Among these is the "Sunset," and other schemes for irrigation, where the bonds have been offered and accepted conditionally by capitalists. The Sunset enterprise has been examined by engineers as to its physical features, and by lawyers as to legal points, both of which have been favorably reported upon after crucial examination, but the Barclays of London, who were to take the bonds, naturally will wait to see if Congress interferes with the standards of value set up in the debentures.

It will be a matter of pride, as well as one of astonishment for people to know that the California Wire Works, of this City, have attained a rank and success in their business, especially in the manufacture of traction cables, that is forcing their product out into distant markets.

Mr. A. S. Hallidie, the president of the Company, is, as our readers know, the pioneer inventor of this form of traction, and has always remained in close contact with the system throughout its evolution of twenty years past, both here and abroad. To a consummate knowledge of the requirements of a traction cable, there is added in the California Wire Works special and exceptional facilities. The works are large and equipped with a special plant for producing cable wire, also for other processes in this novel manufacture, and the company have attained an endurance not equaled by other manufacturers, reaching 15 to 45 per cent. longer life for their cables. A proof of this, as well as a remarkable fact in our local

industry, is the manufacture of traction cables at these works for Eastern lines, or lines east of the Rocky Mountains. The company are now making for the St. Louis Railways, fourteen cables, 20,000 to 35,000 feet long, weighing 400 tons, to be carried over the mountains and delivered against Eastern and other competitors who can transport at one fourth the cost for carriage. Such enterprise and skill in some other of our manufactures would put a new face on the industrial situation here.

We may also mention a very extensive and creditable display at Chicago, where this company has the principal exhibit of skilled production in this City.

Mr. James A. Maguire, of this City, is introducing here the recently invented novelty of "wire glass," a term that is applied to glass having a web of wire cast in the body of the sheets, so as to guard against nearly all accidents that roofing or other exposed glass is liable to. The system is applicable in a hundred ways, even to common and show windows, also to foot lights over vaults, which can by this system be made in large pieces, two feet in width and up to six feet long, strong enough to bear foot traffic. There is no risk of falling glass when it contains the metallic web, and no danger of falling through the glass. On the whole, this seems a remarkable and highly useful invention, and a manufacture of it has been founded near Philadelphia, where more than 5,000 square feet are produced each day. Examples of the glass can be seen at Mr. Maguire's office, 130 Sansome Street, in this City.

The Vulcan Iron Works, of this City, is preparing an aerial ropeway for the San Andreas de la Sierra Mines, in Durango, Mexico, that will be one of the boldest structures of the kind attempted this far. The line will be 15,517 feet long, which is not remarkable in that respect, but the inclination is more than 4,000 feet in that distance, and one span is 1,850 feet clear. The plans and survey offered the usual impediments common to this method of conveyance, which has its main feature in reaching inaccessible places. The machinery and details will be on what the makers call the "Vulcan system," which has been described and illustrated in former numbers of this Journal.

COMMENTS.

We have many times contended that no economical problem would ever be settled until reduced to a mathematical form. It may be a long way in the future, but the time will come when "opinions" must give way to the immutable laws of computation. Mr. W. J. Millar, C. E., of London, has brought to the support of this proposition formulæ to determine the economic speed of ships, and in *Engineering* has laid down a law, which if not perfect, can be made so. There are certain elements, such as the advertising effect of high speed, with many more things that cannot become positive factors, but it is a satisfaction to know there is something that can be learned and depended on. In Mr. Millar's formulæ energy expended divided by power multiplied by space, is assumed as a constant quantity, besides there is the distance traversed, tonnage, value of cargo, and so on, from which he derives the result that 11.7 knots an hour is the most economic speed for freight, and this corresponds very well with observed facts.

A German paper, and with good reason, praises American hand tools. There is nowhere in the world that anything like the same attention has been given to the improvement of mechanics' tools, nor are such tools of like quality so cheaply produced anywhere else. There should be an enormous export trade in these, and will be some day, when such trade is encouraged more by the circumstances of the country. We sometimes have to complain of trashy tools that are run down in quality by competition in trade, but, as a whole, quality is well kept up, and is much better than in the case of European tools, especially those made on the Continent. Tool improvement proceeds from workmen in nine cases out of ten, it may be those who use them or make the tools, but in either case who can apply the implements.

In an obituary notice of the eminent electrical engineer C. J. Van Depeole, of the Thomson-Houston Company, who died at Lowell, Mass., in March of last year, it is stated that at the time of his death he had on file in the U. S. Patent Office seventy-one applications. In the same notice it is remarked that the last patent granted to him while living was filed at the beginning of March,

1887, or five years before. In 1892 was granted one of his important railway patents, which was filed in 1885, or seven years before. This indicates the methods, or rather the state of the business, in the Bureau at this time in certain divisions, electricity and gas engines being farthest behind. Of course these cases of Mr. Van Depeole are not typical, still are not exceptional.

Of all the economic absurdities of our time, and there are a great plenty of them, a "Congressional tariff hearing" is chief. As Mark Twain would say, it is "petrified nonsense." It is of course *ex parte* as the law hath it. Those called are all in favor of a high tariff. They are not even sworn, and there is no evidence of any kind to support the statements they make. It should end, as an anarchronism. If both sides were called it would seem more rational. For example, if the consumers of tin plate, like our California fruit packers, were "heard" at the same time with the tin plate makers that would seem rational and fair. Also the people who wear woolen clothes should be heard at the same time with those who produce and manufacture wool, but joking aside, what would be thought of any other tribunal that would call before it the beneficiaries of some system or policy and hear their statements without oath or support of evidence.

There is strong probability of a profitable export of California wheat to Germany, this coming year. Advance sheets of the consular reports for last month show that a war of tariffs between Germany and Russia has nearly cut off the importations of Russian wheat. The German Government have assessed a special tariff against Russian products of nearly 50 per cent. above the former rates, amounting to 7.50 marks per kilogram or about 80 cents per 100 lbs., almost as much as wheat is worth on this coast at the present time. The importation of Russian wheat fell off about one half between the years 1891 and 1892, from 515,587 tons to 257,299 tons. In 1891 this country sent to Germany 630,213 tons of wheat, 136,129 tons of rye and 10,293 tons of barley, against 257,339 tons of wheat, 123,387 tons of rye and 177,075 tons of barley from Russia. During the first six months of this year the United States have supplied to Germany 152,448 tons of wheat against 8,795 from Russia, but less of other cereals. The Russian tariff is in some cases 500 per cent. on German goods, on "iron wares," it is now 595 per cent., on wire 633 per cent., and on writing paper 418 per cent.

The great yacht race has again terminated in favor of the American sloop *Vigilant*, and our British friends must be getting tired after the many races, eight or more, ran since 1851 to win back the prize carried off in that year by the Americans, at Cowes. In these races as we have a good many times pointed out, it is not a question of seamanship or skill so much as conditions that do not apply to each vessel. In this case for example, besides the enormous keels, the *Vigilant* had a leeboard that much increased her latteral water surface, so to call it, and hence the conditions were not alike. We have no doubt of her being a faster vessel than the *Valkyrie*, but why not limit the competitions to like conditions in respect to "latteral bearings" as well as in length and other things? In beating to windward a leeboard is as much a factor of speed, or distance, as length or any other limiting condition in such races. Both vessels should be fitted and sailed as nearly as possible under the same circumstances.

The Department of State has added to the value of the Consular Reports by sending out to leading journals, advance sheets, previous to binding, when there are special subjects treated. The Interstate Commerce Commission also has adopted this method of advance sheets for use by the press. From a bulletin by the latter Bureau, dated September 25th, for the year ending June 30th, 1892, we find that the number of railway corporations in this country, is 1822, 37 being added in the preceding year. The total number of locomotives was 33,136, and of cars 1,215,092. The number of people employed was 821,415. The sum of the lines amounts to 162,397 miles, covered by a capital of $10,226,748,134, of which more than one half is funded debt. In the way of accidents the number of employed people killed was 2,554, and 28,267 injured, a fearful record. Of passengers, 376 were killed and 3,227 were injured. Collisions caused the death of 422 persons.

The first general meeting of the Society of Naval Architects and Marine Engineers will be held in New York, at No. 12 West 31st Street, on the 16th of this month. There will be an inaugural banquet, and a series of twelve or more technical papers bearing on marine matters. This Society is organized under auspicious circumstances, and the papers announced are relevant and happily, with a single exception, under titles that will not detract from the merits

of the subject matter. The meeting will be held in the rooms of the American Society of Mechanical Engineers, and will, no doubt, be a success in every way. The field laid out for labor is one of great importance, and must be a factor in the rehabilitation of the American merchant marine. Such organizations in other countries have had a wide influence on the development of shipping interests. The address of the Secretary, Mr. W. L. Capps, is at 1710 F Street, Washington, D. C.

Senator Sherman in a late speech in the U. S. Senate made a bad *lapsus linguæ* when he said:

"We ought to pour wealth into the lap of all Europe, and sell them all our products in order to avoid difficulty."

The Senator belongs to a following in this country who have spent a great deal of effort to instruct the people that foreign trade is a bad thing, and that each country should consume its own products after the manner of China down to forty years ago. Senator Sherman has given much, if not most, of his gifted energy in creating and sustaining impediments to foreign trade, and, as we believe, with corresponding insincerity. He is a politician, and so long as it demanded the doctrine of high wages in this country to command votes he, of necessity tried to show that it was a bad thing to import and export goods, forgetting conveniently that there is no restriction on skilled labor, and that a mechanic can work in London, Hamburgh, Manchester or Philadelphia as he may choose.

The Chilean Government have had built in England a new *Blanco Encalda* to replace the one sunk at Valparaiso. The vessel is larger and to steam 22½ knots an hour, and as soon as two or three more of the kind can be provided Chile will be ready for another war. It would be a blessing if the whole armament, land and naval, of the South and Central American countries could be swept out of existence. The revenues are spent in this way, resulting in bankruptcy, and were it not for the jealousy of the great powers would invite early conquest of these countries. A small nation is comparatively, if not wholly safe at this day without an army and navy; with these it is only a question of time, and generally a short time, when disturbance begins. Armies and navies are objectless without fighting to do, and this is soon found when such armaments are prepared.

To those who sneer at the financial condition of Australia it will be proper to point out that the vast debt and deficit there is not for money stolen, squandered, or paid away to beneficiaries. It is the result of building beyond the time. A population of a little more than 3,000,000 have borrowed a billion of dollars and laid it out in public works. In New South Wales especially, every dollar of this money is represented in some kind of improvement, less shrinkage in values. In Victoria we may say more is lost, that is, values have been most inflated there, and there is not the same showing for the enormous amount expended in various public and paternal enterprises. This thing of estimating public debt *per capita* is nonsense. Two countries may owe a like public debt and one be bankrupt, the other affluent. It all depends on the amount and nature of the property owned by the Governments, or in other words, depends how the money was spent. The debt of England, for example, is much of it for highly productive property, like the Suez Canal shares.

Our friend and colaborer, Mr. Watson of the *Engineer*, New York, when he is a line short often finishes out with a little proverb, which if properly expanded would swell up and fill the column. In a late issue we find the following: "Pay as you go; if you can't pay don't go." Here in ten words is the whole scheme of human economics; the secret of failure; the key to dishonesty; and the science of human happiness. If one will stop to consider the share of human wrongs that grow out of "going without pay," what is left will be a beggarly remainder. This motto we suspect is one tacked up behind Mr. Watson's desk, he pays as he goes and makes others do so, but among the great mass of our people in this country how many follow such a rule? To do without what you cannot pay for is the great art of successful life. It is a habit of mind and practice, easy to follow when once commenced, but when the "pay" gets behind the "going," it commonly takes more than a life time to catch up.

There is no doubt that at the present time, and still more in future, American trade in petroleum will be affected by the means of carrying it at sea. There is, it is true, a good deal of the trade that will be held because of the American tin cans that are convenient for consumers, but this is not the most important part. Other countries producing petroleum provide "tank steamers" that, according

to some reports of our consuls, are essential to command the trade. The Swedish builders have done quite a business in furnishing petroleum-carrying vessels, and just now have in hand no less than eight steamers for the Russian oil trade. Our people are in their commerce like Englishmen with their language, think everyone else should adopt it. No one is a good judge of their own methods, besides it is not a question of right or otherwise but one of fact, and if we want the petroleum trade the oil must be delivered in the manner the purchasers prefer, and at prices that they can afford to pay and tank steamers should be provided.

One of our contemporaries tells a story that has a large hint embodied in it. A prominent manufacturer was asked why he did not send out circulars instead of advertising in the trade and technical journal. His answer was that he *sold* his goods to people who read the journals, and sent circulars to those who did not, and for that reason the latter did but little good. This is true of most kinds of skilled manufacture, but it admits of a farther qualification, namely, that the best place to advertise is in journals that are read. A great circulation can sometimes be attained without readers.

The present naval forces of the world, as indicated by the number of vessels and men, is as follows for the principal countries:

Country.	No. of Vessels.	No. of Men.	Annual Cost.
Great Britain	830	98,200	$75,000,000
France	782	88,860	42,000,000
Russia	384	27,790	37,000,000
Italy	344	35,000	20,000,000
Germany	252	19,225	20,000,000
Netherlands	158	13,300	13,000,000
Turkey	142	4,370	5,000,000
Spain	127	9,264	6,000,000
China	105	6,700	6,000,000
United States	92	2,100	31,000,000

The figures are from the *Statistician* for 1893, and if correct involve a very strange showing for this country. Dividing money by men and ships it will show that it costs more than ten times as much to maintain our navy as it does in European countries. This seems impossible, and must relate only to five years past, when immense sums have been voted for construction. The total number of war ships now are estimated at 3,961, and the cost per annum $289,477,000.

The Builders' Iron Foundry, of Providence, R. I., constructed for the World's Fair Commission a water meter to measure the whole supply for the exhibition, estimated at 24,000,000 gallons per day. It is called a 36-inch meter of the Venturi type, designed by Mr. Clemens Herschel, of New York, and is undoubtedly the largest one that has been made of any kind that can be called a service meter.

The gift of lands to what is called trans-continental railways in this country amounts to thirty-two millions of acres, and the bonds guaranteed, or money loaned to the railways it may be called, is sixty-four millions six hundred thousand dollars. This enormous subsidy has been granted to less than 2,500 miles of line, the amounts being as follows:

	Miles.	Acres.	Bonds.
Union Pacific	1,033.35	13,222,400	$27,236,512
Kansas Pacific	394	5,043,200	6,303,000
Central Pacific	742	9,497,600	25,885,120
Western Pacific	121.27	1,552,256	1,970,560
Sioux City	101.77	1,302,656	1,628,320
Central Branch	100	1,280,000	1,600,000
	2492.39	31,898,112	64,623,512

The world has never seen a precedent for such a thing as this, and never will again. Some one recently claimed that the subsidized roads had been bought by the people already twice over, and it certainly seems a tenable claim to make.

The *Railway Review* publishes a facsimile of the fares and time table of the Jaffa and Jerusalem Railway that is an exceedingly complex document for people in this country, being in the Turkish language. The railway does not seem to be managed very well, so badly indeed that the camels remain successful competitors, which is perhaps no worse, if so bad, as teams competing with some of our valley lines here in California. The rate of fares indicate what Mr. Gladstone calls an inequality of human conditions, the first class costing about three times as much as the second class. The distance from Jaffa to Jerusalem is 55 miles, which are run by schedule in 3 hours 45 minutes, or about 16 miles an hour, but the time is in fact something more, frequently double, but that does not matter much in that country.

Those who claim that the present disturbed condition of financial affairs in this country is due to any present or spontaneous cause will do well to read a memorial addressed to Congress by the Commercial Convention of 1890, in which it is said:

"The financial affairs of the country are in a perilous condition. Business men in all of the States of the Union are apprehensive that there will be a panic. Citizens in general are alarmed at the outlook. Values of property are decreasing. Persons, firms and corporations are daily failing whose assets are largely in excess of their liabilities. There is but a single cause for all the above conditions, and that is a want of confidence."

That was the "billion-dollar Congress" that got rid of an excess of taxation, and 100 millions of a surplus, by using up the taxes, and leveling up expenditure to meet the revenue. Causes for financial disturbance are never transient. The system is too unwieldy to be affected by anything but persistent error of a fundamental kind. Tremendous imports to forestall the enhancement of prices under a higher tariff, and a consequent exaggerated revenue from imports, together with an attempt to spend the revenue, are principal causes that, three years later, have depressed prices, and paralyzed the country's business.

ENGINEERING NOTES.

In West Virginia a saw mill cut up (disintegrated) 165 logs in ten hours, which goes to show two things, that the logs had but little value and the purchasers of the product did not care much for dimensions. There is a good deal of analogy between the destruction of buffalo on the western plains and the destruction of timber by these "lightning processes." It has become so bad that one must, in building, "pick out" timber to secure anything near uniform sizes. We have found recently a variation of half an inch in a lot of 2-inch planks, from 1¾-inch to 2¼-inch, or to include extremes, from 1¾-inch to 2½-inch in thickness. Now what is this but destruction? and when one comes to think of the pitiful trifle saved by sawing 50,000 feet instead of 25,000 feet in a day, it becomes imbecility. The time is coming, and indeed ought to be here now, when a purchaser will inquire how "true" machinery will saw, instead of "how much." It requires a long time to bring about changes even after they are demanded.

American locomotives, while rather more expensive, have so many countervailing advantages that they continue to go wider over the world every year. In two years past 355 locomotives have been sold in foreign countries, as follows: Brazil, 192; Cuba, 86; Mexico, 34; Chili, 23; with twenty more to various other places. This is possible because of an organized manufacture with improved implements. The labor costs less than in any country in the world, indeed, must do so because the material used is dearer. But the "rate" of wages is higher than any where else unless it be in Australia. American engines, it is claimed, consume more fuel, and must do so to attain certain results of more importance than the added fuel, unless it be where it is very dear. We cannot enter into the matter here, but it is all written in a redundant literature on this subject, unfortunately not very well known and understood.

It is strange that so little success has been attained in burning culm, or, as we call it, coal slack, in this country. The amount of it laying around is estimated by a contemporary at 300,000,000 tons, waste merely because it is fine enough to run through grates and requires some additional work in firing. Cheap coal is, of course, the main cause of this waste, but where coal is not cheap the same course is followed of dumping the culm clear of the works. In France, where fuel is dearer, locomotives are fired mainly with *briquettes* made from culm, cemented in various ways and subjected to pressure. The main difficulty in preparing this kind of fuel has been in procuring some cheap kind of adherent to keep the material together, and to arrange machinery to work it that will operate without clogging when any plastic substance is employed. On this Coast we have no culm worth speaking of, but instead have an ocean of saw dust that could be condensed for kindling and fuel. Petroleum bitumen is cheaper than anywhere in the world, and kindling blocks at least should be made of this and saw dust.

The support of embankments, where clay forms a considerable part of the material, is a kind of mystery to the unskilled owner and builder of such embankments. In Marin County, opposite this City, for example, there are clay strata all over the slopes, and slides thus caused can be seen on every hand, so the conclusion is that clay will not stand as an embankment unless held by bulkheads of masonry or wood. The fact is, however, that clay stands very well

at an angle of 45 degrees, or 1 to 1, if it is drained ; but runs like mortar at 16 degrees, or 3 to 1, if saturated. It is all a question of water. No other material is so much affected by saturation. It is at the same time the best and worst material for an embankment. A range of 16 to 45 degrees between drained and undrained embankments is phenomenal. Clay embankments require drains to be placed at frequent intervals, and should have laths of wood, straw or other substance laid in, to form leading channels or perforations connecting to the drains.

The Sound steamers at New York are growing the same as their deep-sea brethern. The last one, for the Old Colony Line, now being finished, is 440 feet long, with wheels 35 feet diameter. The engines are double compounded, and set on the British system, at an angle from the shafts downward. The high-pressure cylinders are 51 inches diameter, and the low pressure ones 95 inches diameter, with a stroke of 11 feet, giving 8,000 horse power. There are ten main boilers of the plain tubular type. The displacement of the vessel is 5,200 tons, and the passenger department has 350 state rooms. This is unquestionably the largest vessel ever made of the steamboat kind, and will form the fourth in the fleet of the Old Colony Company that own the *Puritan*, *Pilgrim* and *Plymouth*.

The *Railway Age*, in a late issue, publishes a number of fine engravings showing the new station of the Illinois Central Railway at Chicago. There is a good deal of "station," and the name is happily correct in this case, but there is very little railway. That seems to be outside somewhere for people to hunt up and climb into the cars, the same as passengers get into country wagons at a market. It is certainly a cheap way to run trains past, instead of into a station, and it is in some sense practical for an active person to cross half a dozen lines and climb up a pair of stairs to a carriage, but it is not modern convenience or in the line of it. Among other regulations that show "animosity" to railways we may some time expect one that will oblige railways to provide platforms at their stations, so passengers may walk instead of climb into and out of the trains, also to embark and discharge passengers without compelling them to cross from three to a dozen lines to get to or from a train. It is a crude system—an imitation of the country road wagon, but it is cheap.

The *Compass* quotes from *Indian Engineering* as follows:

"The expense of theodolites appears to be due to the accuracy of parts in their construction, necessitated by the readings being taken directly from the scale of degrees. The introduction of mechanism like a watch would enable a theodolite telescope, when turned through a certain angle, to indicate that angle in degrees, minutes and seconds by hands moving on a dial with perfect accuracy, the only inaccuracy arising from a *play* between the teeth of the wheels used, which can be eliminated."

This seems a considerable suggestion, and it is to be questioned whether instrument makers could not by means of multiplying gearing, and revolving pointers simplify readings, and attain sufficient accuracy thereby. Wheel teeth can be made without play, and as to pitch, we would as soon trust that as the dividing done for instruments.

ELECTRICITY.

NOTES.

The art of electric welding of metals seems to have made wonderful progress at the hands of Mr. G. D. Burton, of the Boston, Mass., Electric Forging Co., who are exhibiting a welding plant at Chicago that, all things considered, is the strangest exhibit of its class. The main conductor from the transformers to the forges is of copper, 3 inches diameter. The voltage is from 4 to 30 and the amperes 6,000 to 10,000. The Electric Forging Company of Boston seems to have made the greatest possible progress, having founded four or five years ago a forging and welding works on "business principles" to operate for the trade, and have no doubt succeeded commercially as well as electrically. In comparison with fire processes there are many striking differences, especially as to the conditions of the metals under treatment, there being no sulphur dirt or other foreign element to contend with, but the strangest thing of all is that metals and alloys of almost any kind can be welded.

The most novel application of electricity for some time past, is the welding of the rails on the West End Railway at Boston, Mass. The shop, so to call it, is a box car containing a 250 horse power motor dynamo, furnished by the Thomson Electric Welding Company of Boston, generating a current of 500 volts by means of an initial

supply from the overhead wires. This current is transformed into one of 3,000 volts, and passing the transformer of the welding apparatus at the forward end of the car, is applied to the ends of the rails to be welded at 40,000 amperes. There are independent motors to propel and control the car. The welding mechanism is supported on a crane and is swung from side to side so as to weld the joints as they come. There are cooling appliances and quite a plant of mechanism for gripping and pressing the rails. The scheme was originated by the Johnson Company, of Johnstown, Pa., and has proved successful. The total weight is 30 tons.

The U. S. Consul at Buda-Pesth, Hungary, writes as follows concerning the conduit railway then constructed there more than three years ago :

"The Siemens-Halske electric street railway system was introduced into Buda-Pesth three years ago, and is now in operation on nearly 7 miles of double-tracked road. Sixty cars, each with a seating capacity for thirty-two persons are run over the line at an average speed of 12 miles an hour. The electric current is transmitted from a central power station through an underground conduit, from which connection is made to the motor of the cars.

The service has been exceedingly satisfactory to the public, the only short interruptions having been caused on a few occasions by unusually heavy falls of snow. The rate of speed could easily be doubled, but municipal regulations forbid any increase.

The fare charged varies from 2½ to 4 cents, according to the distance. Transfer tickets are issued for 4 cents.

The company operating the road has obtained concessions for an extension of about three miles over some of the principal streets, and further concessions will probably be secured.

The following facts in relation to the construction and equipment of the railway were furnished by parties in this city (the company publishing no reports): Cost of railbed (rails, excavating, masonry, paving, and switches), about $2,880 per mile of single track; cost of cars, including motors, $6,000 each; weight of cars, including motor, 5 tons; cost of buildings, $15,000; five boilers, with grates and masonry, $20,000; machinery (engines, dynamos, switchboard, etc.), $70,000; cost of running one car per mile (maintenance of track, labor at power station, fuel, employees on cars, etc.), 5½ cents."

A foreign journal claims that while the Americans are well up in nearly all branches of electrical construction and science, and ahead in most other things, they are far behind in electrical storage, and this we think is true, to a great extent at least. Storage is not a

laboratory problem wholly, in fact is only partly so. The endurance of electrodes is mainly a mechanical problem, and one that mechanics must deal with. Certain dynamic forces are set up that must be resisted or compensated by mechanical means, and such means are not very likely to come from a laboratory. It is true that the storage business has been hedged around with patents that have for ten years past been tossed about like shuttle cocks from court to court, forming an embargo on experiment or hope of commercial reward, but these patents will soon expire, and then, no doubt, will come a period of vigorous research in batteries and the accessories of the accumulator system.

MINING.

NOTES.

Under the head of "The Greatest Mining Invention of the Age," we find in our foreign exchanges the following :

"It is an apparatus to enable rescurers to enter a colliery immediately after an explosion without feeling ill effects. It consists of 'an air bag, an appliance to hold the nose shut and a battery and a small incandescent lamp.' The air bag is of canvas, and is worn on the back and fastened under the arm. Air is inhaled by the mouth from this bag by means of a rubber-tube connection. The battery is strapped about the person and the lamp is pinned to the coat. The invention, as it reads, seems very nice and useful, and we therefore wish it every success; but we must confess that, while the inhaling portion of the opperation appears to be in order, we do not quite understand from the description before us how the man is to get rid of his carbonic acid if his nasal organ is stopped up. Possibly, however, the 'appliance to hold the nose shut' is capable of permitting the egress of breath while it prevents the ingress of a vitiated atmosphere."

The latest thing in ore concentration, or selection it may be called, comes from Germany, the principal being separation by centrifugal force. The pulp is fed on a rapidly revolving disc and spreads from the centre to the periphery, the fine dust is drawn off by a fan, and circular troughs around the disc catch the various grades owing to their gravity. This seems an old idea in most respects, but we suspect there is more in the process than the simple account indicates, because the Fried Krupp Works at Essen have undertaken

the manufacture, and anything to command the attention of a company employing 16,000 men must have novelty and merit. Some of the Broken Hill silver ore has been treated in Australia with good results. There is just now in Australia quite an inquiry and a good deal of experiment going on in concentration, as there has been at times here and in other mining countries, but we imagine the summing up will not show much gain over present processes.

Messrs. the Park & Lacey Co., of this City, are furnishing in Australia some small mining plants that we think they could well imitate here. The whole plant, consisting of a portable engine, with a Dodge stone breaker, ore feeder, shaking table, 42-inch Huntington centrifugal crusher, and amalgamating table, for the sum of £675 or $3,375. This plant will crush 10 tons a day of fair ore and save, as it is claimed, 85 to 90 per cent. of the gold. It is a question, all things considered, whether in mining plants as in most other kind of work, aggregation means cheapness of the processes. Wherein a plant will keep the men continually employed in necessary attention, it is large enough to crush cheap and there is the avoidance of what may be called ornamental expenses. Every detail is under the eyes of the attendants and the result is always before them, so there are gains as well as losses. One gain is stability of the business, not exhaustion of the ore in a few years and a tremendous wreck of plant to be carried to loss account.

A diamond called the "Excelsior" has been discovered at Jagers Frontier, Orange Free State, Africa, that completely eclipses the Koh-i-noor and all other diamonds. The Kerr diamond mines, where the great jewel was found, are included, or mainly included, in the Kimberley de Beers combination, and are celebrated for large diamonds. This last, the great Excelsior, which weighs 972 carats, is 3 inches long, 2½ × 1½ inches. The value is estimated variously from $9,000,000 to $15,000,000. Just how it is to earn this amount is not clear. Perhaps it is worth that much to demonstrate the fact that the value of all things, especially gold and silver, is based on the expense of its procuration. This is the law of all values, and if diamonds were as plenty as acorns they would bring the same price per bushel.

It is well known that the waters of the ocean contain gold, one grain to a ton, which is not hopeful in the way of extraction, except by figures. In that way the prospect is amazing. Professor Rickard, of Denver, Col., has been computing the matter and finds there is 10,250 million tons of gold in the sea. We do not dare to turn this into money for fear of depressing the price of gold, but when the amount of water is taken into account the gold figures become attenuated. For example, 400,000,000 cubic miles, whatever that is, there can be no human comprehension of such a thing, and need not be, for, as before said, there is poor prospect of extraction. The gold in sea water is in solution as an iodide, and the most useful lesson to be drawn from the fact is that this may explain original deposition in metallic form.

MISCELLANEOUS NOTES.

The new ships being built for the American line by Messrs. Cramp, at Philadelphia, are a little shorter than the *Paris* and *New York*. The engines are to be quadruple expansion, which is, we think, a doubtful extension in that direction for such large powers. The ships will have 15,000 horse power, or 25 per cent. less than the British-built ones in the same line, and unless there are improvements in lines or otherwise the speed must be a good deal less.

Counting one ton of steam-propelled vessels equal to four tons of sail, the British have at this time 17,250,000 tons, and more than the whole world beside. This is pretty hard to realize, especially if one has been reading some of the speeches made in Parliament along about 1845, when the Navigation Laws were repealed, and the whole industry thrown upon its own resources. These speeches predicted a total destruction of British shipping interests.

The *Manufacturers Gazette* says the exports to England of leather and shoes during six months of this year was $5,245,941, also in an adjoining paragraph, that our exports of paper and paper material to that country is constantly increasing. This should not be. According to the *Gazette's* philosophy, the English should make their own shoes, and tan their own leather, and there should be a duty on hides in this country to stop importation, also a duty in England to stop the leather products sent there.

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JOHN RICHARDS, EDITOR.

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A SHORT SENTIMENTAL JOURNEY.

The title above, a plagiarism from Lawrence Sterne, the gifted author of *Tristram Shandy*, is selected not because of relevancy, but because there is precedent of its use to cover "things in general." He made a journey to the Continent of Europe and noted down his impressions of a medley of circumstances, small and great, mostly small, with the license permitted by an absence of all plan, and almost without connection.

The elements here, to so call them, are a motive agent — a quiet mannered horse, capable of management by one whose nearest precedent was steering a boat; a four-wheeled vehicle, supplied with some tackle, and a driver without any fixed purpose or destination beyond a progress forward, so long as motive power was adequate and controllable. This, with a start up the Marin Peninsula opposite San Francisco, completes the "introduction," condensed to its lowest possible limits.

The first observation is in respect to roads, or the spaces left for roads which may sometime exist, and the fact that these "ways" are of widely varying quality.

The "Supervisors," as they are called in California, a kind of committee in general on county affairs, have their *loci* in the county towns, and as the purpose is naturally to stop as much of the traffic in these county towns as possible, and prevent its going on to the

city, consequently the roads on the city side are as bad as possible, while on the other side, away from the city, the roads are, if not good, so much better that one can scarcely make comparison.

In this case the Marin County Peninsula, extending down within hailing distance of San Francisco, and accommodating the local traffic of the roads of the county, are abominable. They are ungutteredd, ungraded and ungravelled, while to the north of the county town, San Rafael, the roads are good—good in comparison. These roads, good and bad, like all others, have branches, and the stranger when he comes to a "fork" is left to the device of guessing and trying which is the one desired. Trying consists usually of driving one or two miles, getting out at a farm house to inquire, and then retracing the course. Because of some diabolic instinct one always takes the wrong road.

Here comes the inquiry that when a maker of haberdashery and baking powder firms can send out men to nail up on trees and fences hundreds of neatly painted advertising boards, why cannot the Supervisors of a county set up a few guide boards at cross and branch roads to indicate their destination. In 70 miles, three of them ; and these illegible, hanging by a corner or turned upside down.

From this fact comes the inference that three Supervisors, like three cooks who spoil the broth, are just two too many, and that all public business of whatever kind when managed by a "Commission" is not managed at all. The public works of this country are its shame, as its private works are its glory. The adage of "the best government is by the best people" should be revised to say, "by one person who is honest and capable."

Around San Francisco Bay lies most of California. The counties that abut on the bay, nine in number, contain one half the population and represent two thirds of the State's production. These counties cover valleys that reach back from twenty to eighty miles, and our course lies up the first one, counting from the ocean, and in many respects a strange one, the Santa Rosa Valley, so called, but wonderfully misnamed. The Petaluma Valley, about 25 miles long, enters Santa Rosa "Basin," a vast plateau, circular in form, two or three hundred square miles in area, with its drainage to the north into the Russian River. It is not a valley, but a basin, and a wonderful one. This basin and its approaches is one of the richest and most highly developed districts in California.

The fact that most impressed us here, was "tramps"—thirteen of them, met in twenty miles, or assuming the "traffic" equal,

twenty-six, counting both ways. It remained for a Californian, Henry George, to proclaim a true genesis of tramps, and he certainly did not lack facts to observe in so far as examples.

We spoke civilly to each one passed, and in half the cases had no response but a scowl or averted heads; in other cases hesitating return of our salutation. The horse, vehicle and general outfit was construed as belonging to some thrifty native of the rich country around, and brought to mind a story told of Western Virginia, as follows:

A traveler in passing through one of the poorest of the mountain districts came upon a native at the roadside chopping wood. He was clad in ragged "butternut" trousers, a more ragged shirt, and other clothing none whatever. The traveler was so astonished that he stopped to look at the man, who became annoyed, and said: "You needn't look at me. I aint so darned poor as you think I am. This land don't belong to me."

If we could have done similarly, and explained the nature of our impecunious calling and that the land did not belong to us, the tramps would have been more communicative.

In all there was a cowed, despondent look, and on inquiry in a number of cases it was learned that these men are not feared. They are commonly spoken of as "a nuisance." Not even women or children are afraid of them, so their condition cannot be set down to criminal propensities, or anything worse than some social condition that is piling up a fearful reckoning for some time in the future.

In San Francisco has been set up a "factory of tramps" under the name of "help to the unemployed," charitable no doubt and commendable in its ethical phase, but a means of producing tramps. These unemployed by the natural laws of selection will be sifted down to those who do not want to be employed, and if the numbers increase, as is probable, there will be a new social problem to be dealt with at the end.

One of our countrymen, Count Rumford, a Connecticut schoolmaster, rid Bavaria of tramps in such an effectual manner, and humane withal, that he received a title and became famous. He is better known as the discoverer of the mechanical equivalent of heat, the missing dynamic link that has brought cosmos out of chaos in our knowledge of natural forces.

California is to be the great home of tramps—is indeed so now. All natural circumstances favor his nomadic life, but here, as elsewhere, there must be a solution some time of the causes that produce him.

From the Santa Rosa Basin the course is in a true valley, that of the Russian River, which is not, however, a valley, but a cañon, with rocky, precipitous sides, and roads that are appalling. On the right lies a range of mountains 3,000 feet high, that form the "rim" of Lake County, the "Switzerland of America," as it is called.

This ring of mountains enclose a lake thirty miles long and five to ten miles in breadth, into which great volumes of pure water are emptied, also the mineral laden flow from hundreds or even thousands of springs which impregnate the whole, but not to the extent of preventing fish and other marine animal life. The fish are of the "hard" varieties, not of much use and, as I am informed, are of the varieties that do not "bite."

Clear Lake is 1,300 feet above the sea, discharges its overflow through a stream called Cache Creek to the Sacramento River.

Lake County consists of a mountainous district filled with summer resorts of unequal comfort and merit, all situated at mineral springs and called "springs." The local population in the mountains forms an economic and social study. Southern customs prevail in some parts and remind one of Western Virginia or the Tennessee mountain districts. Other places are British, and some are New Englandish. There is a strange diversity.

Here is a field for small electric plants, which are just now engaging attention. The local requirements are for lighting, churning, cutting wood and so on. There is water everywhere and fall at pleasure, but what excites most interest to a stranger is the strange productive power of the land. Where this is written, 3,300 feet above the ocean, there are peaches, apples in profusion, grapes, and indeed all but tropical fruits. This county, that one would set down as a barren waste, could support the whole population of California. Animal life, too, takes its most vigorous form. Here one sees, as they cannot in many places in California, the finest kind of swine, such as are bred in the middle counties of England.

Two thousand three hundred feet high, at Seigler Springs, are vast bodies of conglomerate, deposited from fifty or more mineral springs there, loaded with magnesia, alkaline salts, arsenic and iron. A fine building, 30×50 feet, is built of blocks quarried from ancient deposits of the mineral springs. There are blowing springs, giving off volumes of carbonic acid gas, scalding water, cold water, charged with iron, sulphur and what not.

What is the future to be of this mountain country? Inference assigns it as the Spa of America. Tempered by warm winds from the Pacific,

a temperature that seldom goes below 30 degrees in winter, attainable by easy roads through a score of passes and cañons.

This matter of roads brings up an anomaly. The easiest grades in California roads are in the mountains, where the inclinations are "chosen." Out of this lake basin, where there are thousands of acres of rich level land, the products are hauled over the mountain roads rising thousands of feet. The loads are at the rate of one ton for each horse. A little more than the same horses could haul through the streets of Philadelphia.

Wheat, hops and prunes seem to be the main products. Wheat just now is laid under embargo. It costs one fourth of its value, $5.00 per ton, to haul it over the mountains 15 or 20 miles to Pieta, at the railway; another $5.00 a ton to haul it down grade by railway to the bay, when one half its price has been consumed in transportation, leaving half a cent a pound to the farmer; but even this pittance is further paired down by ingenious schemes that are born of cunning and adverse laws, until the farmer is in despair.

About 45 per cent. of all he purchases in return for his wheat is federal taxes. For his crockery he pays 30 to 40 per cent. for goods and 60 to 65 per cent. of taxes, and when at table you ask him to turn his dishes over and examine the trade mark on the bottom, he is amazed to find that these dishes which he pays from 55 to 65 per cent. to have made at home, have come from Staffordshire, in England. One half for transportation and 50 per cent. of the balance for taxes leaves the farmer less than 25 per cent. for his wheat, or at this time 25 cents per hundred pounds, about 20 cents per bushel, and then we wonder what makes tramps!

* * * * *

He who is rash enough to attempt driving in this country needs a vehicle of the standard gauge to follow the stages and freight wagons, also wants two horses—not one. The roads have a ridge in the middle, with paths on each side. A single horse must walk on the central ridge and climb over boulders, a kind of athletic performance that disturbs his equanimity and exhausts his energies; also, if he is a sensible horse, arouses his indignation and provokes plans of dumping the driver "over the bank."

To again speak of roads, two years ago began in this county for the first time some serious consideration of how roads are to be provided, but three fourths of such attention, if not nine tenths of it, has been given to methods of making roads, the engineering part, to so call it, which has about the same relative importance in making

mountain roads that the paint on a house bears to the structure itself.

There is no difficulty whatever in determining how to *make* roads with centuries of experience to guide, but the problem is in administrative management of the work itself, and more especially the provision of funds to pay for roads.

As a general rule a road, street, or indeed any means of public conveyance that comes under the head of "way," must depend on the values that lie along its sides. This determines the volume of traffic and is a measure of the means available for construction, under present systems at least, and there are many reasons for centralizing this matter of road administration. County management is discriminating generally, and inefficient always. It is a kind of everybody's business, and consequently nobody's business to look after roads.

An hour before writing this we for the third time climbed over a pile of boulders in a county road that very nearly bars the traffic. One hour of a skilled man with bars, gabs and some dynamite would make a turnpike of the place, but there is neither the man nor the tools, and no one to set him at work. It is the "other fellow's business."

* * * * *

To again speak of the people, what a paradox is this mountain life? Here with a salubrious climate, rich land and a profusion of all natural resources, is a rural population, helpless, struggling for existence one might say, in a natural sanitarium! "Old Virginia" is seen on many sides. The Missourian has brought his old ideas with him and clings to his habits and ways of life which are a modified form of what is found in Georgia, Tennessee, and Alabama; Englishmen also, with their methods.

Here and there people from New England have gained some foothold and the transition from a humid, clouded and cold country, or a sterile cold granite one, where agriculture was a bare possibility to where it is almost "self acting." While this has weakened the energy of the people, it has not permitted them to lapse into "crackerism." They have neat farms, good teams, clean houses, and "work." One can tell at once on approaching a farm, or hotel, whether it is owned by the "Missourian," the New Englander, or a Briton.

* * * * *

Around the highest benches of the mountains are wonderful mineral springs, mentioned before, and at these springs have been

erected houses and accommodations for the hundreds of people who come here in summer, and dozens who remain through the winter. Rich people go up there for treatment, drinking and bathing in the waters, and through a conjunction of causes are nearly always benefited or cured. In the leisure of such periods the business instincts keep at work, and the rich invalid either buys out the springs, or some land near them, so that in passing through the county one hears continually the names of prominent men in San Francisco.

Just at the time of writing this, a loquacious Swiss barber informed the writer that the Spring Valley Water Co. of San Francisco, have a large "ranch" at the foot of Clear Lake, where Cache Creek begins, and 300 acres of vineyard in full bearing, and that hogs have just been turned into this vineyard to eat up the grapes, which have no value! Think of feeding hogs, that do not need the food, with fine grapes, worth twenty cents a pound in New York, Philadelphia or Boston!

"Wine's no good," said the barber; "can't sell it. Nothing is any good here except it is of high value in proportion to weight, so it can be teamed out." We asked him what his countrymen would do if turned loose in this country instead of their poor untillable land in the Alps. "Most of them would get lazy," said he, "and do no good. There is no market from here we can reach, and it is too easy to live." We did not believe him.

The swine of these mountains is mostly of the genus "razor-back," a long-nosed black animal, that has neither profit nor good qualities in him. In some cases we found the finest English breed of hogs, Berkshire and Chester types, and one would think that in a season or two the "razor-back" would disappear; but nothing of the kind. The native hog is in a sense a wild animal. He can subsist on acorns, which are just now falling, and remain on, or in, the ground all winter. The "razor-back" is a born excavator. His long snout and rooting powers are a work of evolution, and as a forager or self-sustaining animal far excels his refined cousins from English breeding sources. He is fleet of foot and not easy to capture, so is not eaten by the hungry huntsman, who obtains his "meat from the woods." A lazy awkward Chester pig can be driven in and slaughtered conveniently and safely, but a razor-back can only be shot, or caught with dogs, and sometimes reverses the hunt by chasing the dogs. We have thus gone on and perhaps answered the query of why this breed of long-nosed hogs are kept up here in the mountains.

It is amusing, also instructive, to see the woodpecker, blue jay and grey squirrels, at work laying in their winter store of acorns. The woodpeckers bore holes in the thick bark of the pine trees and wedge in the acorns neatly and firmly. One tree will have hundreds of such holes, bored from one and a half to two inches deep, and often plugged with small stones to preserve the nuts. If a squirrel ascends one of these trees when the nuts are *cached*, there is a great hubbub. The birds issue a warning call and dozens of them assemble, flying at the squirrel and scare him off their preserves.

The blue jays deposit their stores in such ready made places as offer, and lead a lazy life. They can in a short time carry off and *cache* all the nuts required. The squirrels have a much harder time. A long way to travel on foot and more trouble to secure the nuts, also have to keep a continual lookout for death-dealing guns. They are the finest of all animals in these mountains, a type of perfect symmetry, active to a degree that no other animal attains, and with all kinds of amusing antics and devices, the object of which no one can understand.

Many years of association with these charming little animals as pets has eradicated the ferocious instinct, and we would no more think of killing one than murdering a fellow human being.

His scurvy brother, who spoils his suit and wears off his bushy tail by burrowing in the ground, and who is a native Californian, born of the treeless areas in the dry belt, also lives here in the mountains, around farms mostly, because his natural instinct is robbery. He will sit quietly concealed, watching until the horses or other cattle are fed and the owner leaves; then he will sneak in and carry off his pouches full of grain.

The California ground squirrel is a "tramp," a degenerate tribe that took to the dry ground where there was no timber, and finding this vagabond life easier has stuck to it until he has developed a new species of his kind. Guns, traps and poisons do not much diminish his numbers, because his closer association with mankind has sharpened his wits and widened his audacity, until he has reached the very extreme of vagrancy.

Over Mount St. Helena pass and down 2,300 feet in one grand slope, into Napa Valley another — over the next eastward outlet from this mountain basin — one hundred and twenty miles in three days, pass in these notes and finish. THE DRIVER.

NOTE ON THE DUTY OF THE CALIFORNIA WET-CRUSHING STAMP MILL.

By Luther Wagoner, Mem. Tech. Soc.

[Presented before the Technical Society of the Pacific Coast, Oct. 6, 1893. Reprinted by permission.]

An examination of the tabulated statement of facts concerning all the stamp mills, as given in the Eighth Annual Report of the State Mineralogist (California), pages 692 to 695, shows that the output of any mill can be closely approximated to by taking the product of three factors deduced from the data given, as follows:

The foot pounds of work done by the falling stamp;

The $\frac{2}{3}$ power of the screen aperture;*

A coefficient of hardness.

NOTATION.

W = weight of the falling stamp in pounds.

D = drop of the falling stamp in inches.

N = number of drops of stamp per minute.

A = width of aperture in screen in inches.

T = tons crushed per stamp per 24 hours.

K = coefficient of hardness, and for which the following values are suggested:

$K = 13$ for very hard and tough quartz.

$K = 16$ for hard and tough quartz.

$K = 22.7$, the average of all the quartz crushed.

$K = 30$ for soft quartz with clay, etc.

$K = 40$ for rotten quartz with clay, etc.

$K = 50$ for soft talcose slate, and rotten quartz with gouge.

Then:

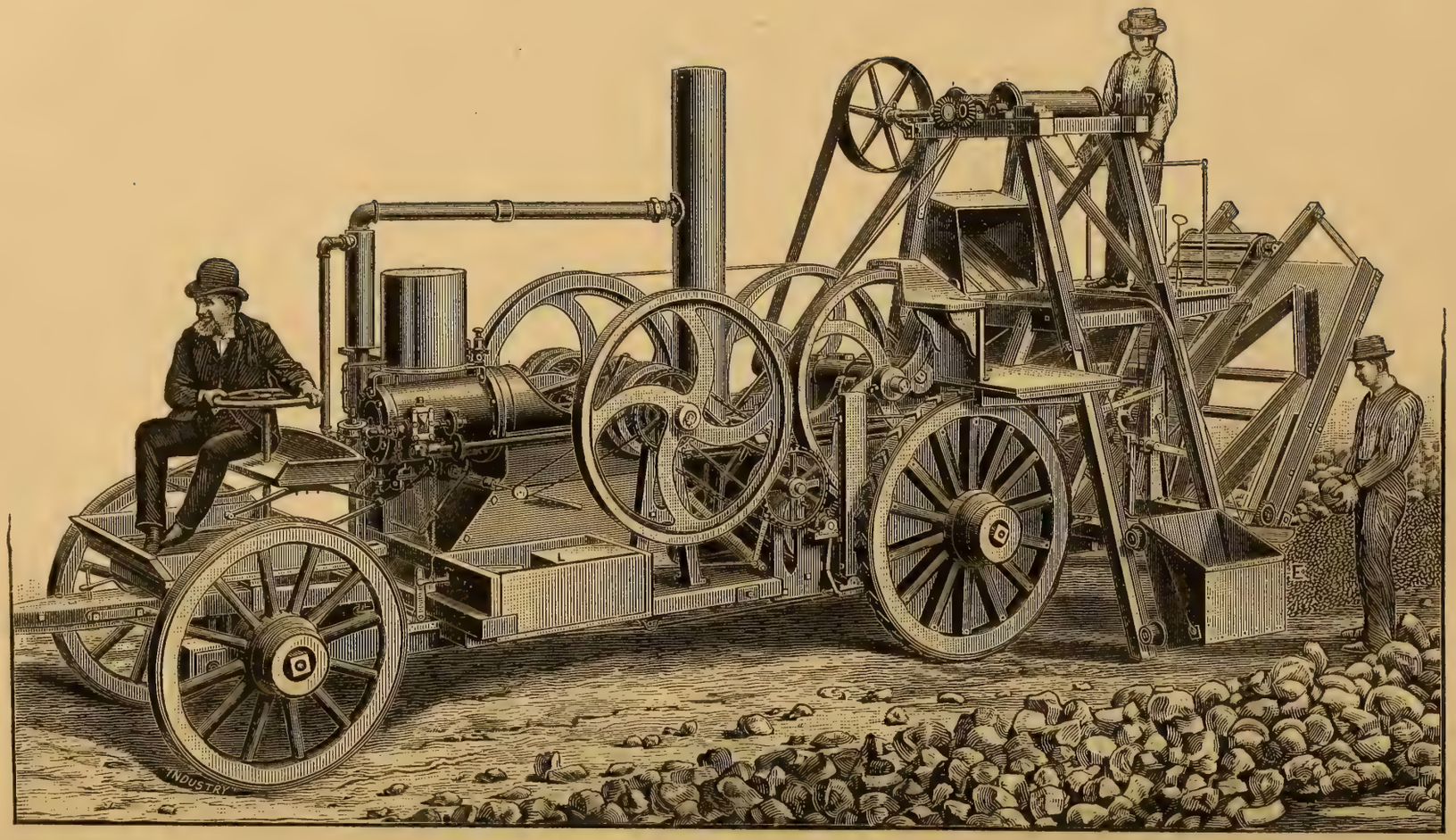
$$T = \frac{K.\ W.\ D.\ N.\ A^{\frac{2}{3}}}{1{,}000{,}000}$$

The above formula is to be used for slot-punched screens.

Taking $W = 900$, $D = 6$, $N = 90$, $K = 22.7$, the following values of T are found for the different screens:

No. 4 screen,	$T = 2.85$	No. 8 screen,	$T = 2.43$
No. 6 "	$T = 2.65$	No. 10 "	$T = 2.20$

*The crushing power per foot pound of work is inversely as the screen aperture, while the discharge must increase with the aperture from the first to the second power, depending upon the form; hence $T = f\ A^{-1}\ f\ A^{1\text{ to }2} = f\ A^{\frac{1}{2}+}$; $\frac{2}{3}$ is adopted for the exponent as more nearly according with data mentioned, and for slot-punched screens. $\frac{3}{5}$ is the value of exponent found for some dry crushing work with wire-cloth screens.



PORTABLE ROAD MAKING OR MACADAMIZING MACHINE.—KNIGHT & CO. SUTTER CREEK, CALIFORNIA.

PORTABLE ROAD MAKING MACHINE.

KNIGHT & COMPANY, SUTTER CREEK, AMADOR COUNTY, CALIFORNIA.

Mr. S. N. Knight, of Knight & Company, at Sutter Creek, in this State, has at various and frequent times contributed a good deal to the public and industrial interests of the State and elsewhere by his engineering skill.

We have had occasion to describe his immense derricks, at the Arroyo Seco Mines, for handling gravel, and his direct hydraulic pumping engines, which are, as we believe, the only successful ones of the kind in this country and perhaps in the world.

The latest production of Mr. Knight's skill, is the machine shown on the opposite page, for almost automatically macadamizing common roads. It is "automobile" propelling itself and advancing as the stratum of deposited road metal is thick enough.

The machine consists of a gasoline engine, stone breaking machine, an elevator for raising and distributing the material from the roadside, and apparatus for sorting and delivering the broken stone so the coarser material forms a substratum and the finer is deposited on the top. The machine prepares eight tons an hour, and a mile of road can be prepared in two weeks' time, at a cost not more than double that of clearing a road of loose stones for a season. This latter work has been the subject of a contract on the road leading from Ione to Sutter Creek, and it is singular to think of paying men to clear a road from stones instead of breaking them and completing the process of forming a turnpike.

The machine shown in the drawing was contracted under exacting stipulations for the Supervisors of Amador County, and has been at work for some time performing successfully all the required conditions.

We will not enter upon a technical description of the machine. The drawings convey to a skilled reader, a complete idea of the whole, even to the inventor himself, who will be recognized by his many friends.

The works of Knight & Company, at Sutter Creek, are worthy of a visit by anyone interested in novel engineering work. They are isolated and set down in a group of mines, where on all sides and continually there is a wide field for observation and experiment. The work is made from accurate drawings by good implements, many of them special, the practice is good and not at all what one

would expect to find in a mining town in the mountains.

The facilities for hydraulic experiments, both for power purposes and for water raising, are complete, and among other things, a table for friction heads has been made out from actual experiments with common pipe, that is of much value.

This latest production there, is the road making machine, and is opportune because it is to be hoped we are at the beginning of a general reform in roads in this country. It is a problem of cost in sparcely settled districts, which means nearly all of this State.

There is no lack of constructive data or knowledge of how roads should be made, but whatever cheapens the cost is the main thing in attaining improvement.

POWER DISTRIBUTION ON WAR VESSELS.

Among the papers on dynamic subjects read at the Engineering Congress at Chicago, one of the most remarkable was that of Mr. G. W. Dickie, manager of the Union Iron Works, in this City.

The paper was entitled "Auxiliary Machinery of Naval Vessels," and was confined to the subject as embraced in that title, but it is easy to see that power distribution by any means, while it may have peculiar features and requirements on war vessels, is a general subject, and Mr. Dickie's propositions have a much wider range than is indicated by the title of his paper.

We had the privilege of looking over a draught of this paper in its preliminary form, and expect to publish it in full at a future time, but at the present will reprint a synopsis by Mr. Wiley, of New York, written for *Engineering*, London, as follows:

"A very interesting paper succeeded the foregoing, entitled: 'Auxiliary Machinery of Naval Vessels,' by Geo. W. Dickie, manager of the Union Iron Works of San Francisco, from which works the United States Government has just received five additions to the war ships. He classified the subject under two heads:

'First, those that perform duties dependent upon the running of the main engines, and which have become detached machines, through a process of evolution in design to meet some of the difficulties of higher pressures and higher speed.

Under the second head we would place all the auxiliaries whose functions are in no way dependent on the operation of the propelling engines.'

Under the first head he considered condensers, air pumps, circulating pumps, auxiliary condensers, and the feed system. Under the head of auxiliaries not dependent on the running of the main engines, he considered the drainage system, fire service, and the

blower engine. He then considered the auxiliaries not driven by steam, and recommended hydraulic pressure, obtained from Pelton water wheels, operated by jets of water at 600 pounds pressure per square inch, for operating the turrets, the blower engines, the reversing gear, dynamos, anchor gear, windlass, winches, boat cranes, capstans, and steering gear. He next dealt with the hydraulic power necessary for this, and fixed it at two sets of pumping engines delivering 386 cubic feet of water per minute, and concluded this admirable paper as follows:

'To sum up, what have we gained by this method of converting the steam into water pressure, and distributing it to the various auxiliaries throughout the vessel?

'We have concentrated the production of this power, placed it in a central position directly under the care and supervision of the engineer officers.

'In the central compartment would also be placed the auxiliary condenser with its circulating and air pump, where it would condense the steam from the engines operating the hydraulic pumps.

'There being no auxiliary steam engines scattered throughout the ship, the auxiliary steam and exhaust pipes would all be dispensed with.

'The converting of the water pressure into mechanical motion being accomplished almost without mechanism, no skilled attention is required at any of them.

'The flooding of any compartment would not affect the transmitting of power through the flooded compartment.

'Repair would be reduced to a fraction of what it now is.

'Less lubricating material would be required.

'Auxiliary steam engines that work intermittently use a good deal of cylinder lubrication, which is carried to the auxiliary condenser, and must either be filtered out or get into the boilers.

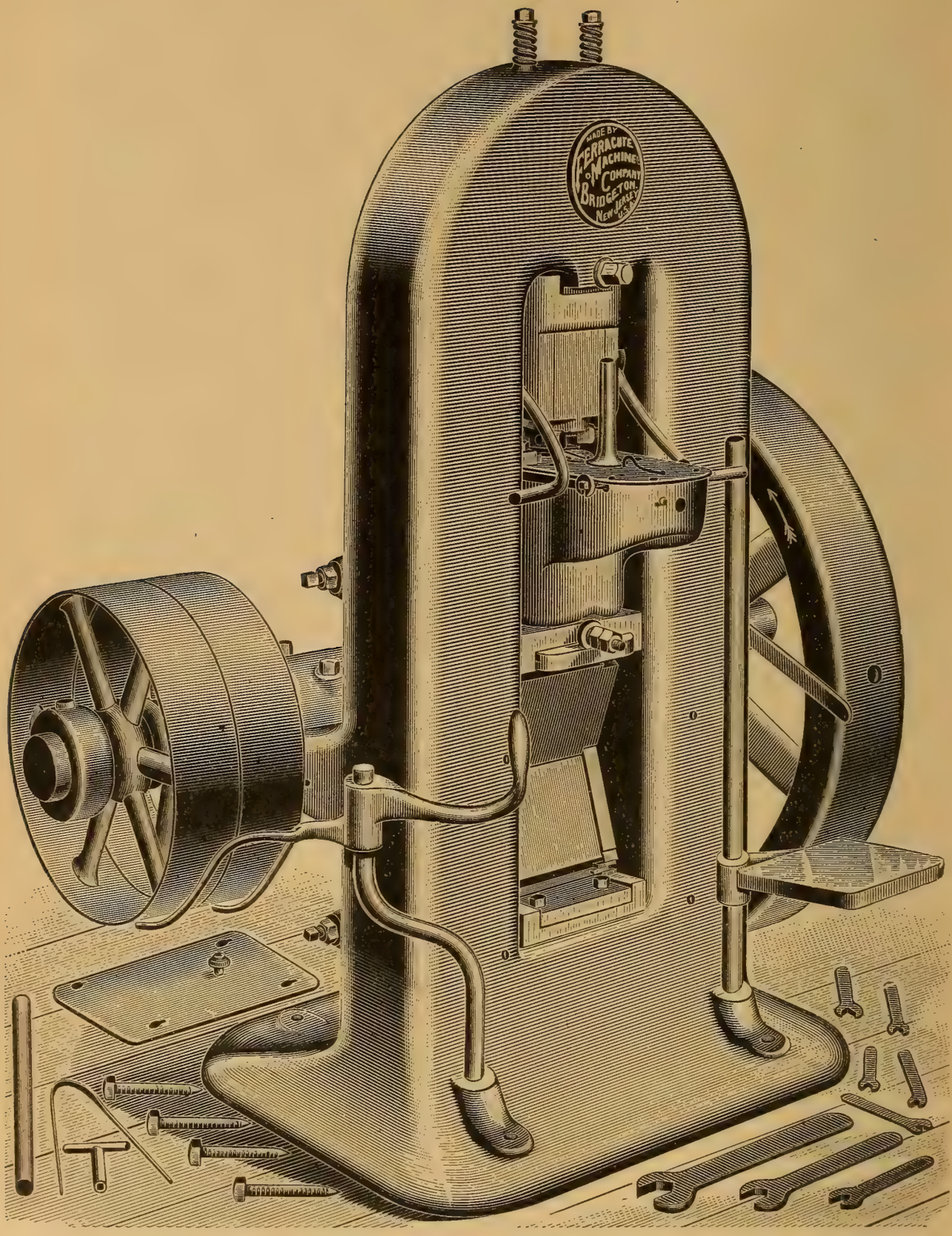
'The saving of weight, on a very moderate estimate, would be 69,850 pounds.

'But most important of all is the fact that the action of the water on the wheels we propose to use is absolutely certain, and never fails, while the absence of reciprocating parts renders a breakdown hardly within the possibilities.

'What we propose, while new on board warships, has been developed through a long series of exhaustive experiments into a very extended use in the Pacific Coast States, where the principles involved are thoroughly understood, and where the results to be obtained are matters of fact and not of experiment.

'When we consider the ponderous machines hitherto used for converting the power in high-pressure water into mechanical movements, it is not surprising that it is a revelation to many well-informed engineers, and that they find it difficult to comprehend the marvelous results obtained from mechanism so simple as compared with the older method.'

This paper was accompanied by a full set of illustrations, and received marked and thoughtful attention and discussion."



AUTOMATIC MONEY-COINING PRESS.

FERRACUTE MACHINE COMPANY, BRIDGETON, NEW JERSEY.

AUTOMATIC MONEY-COINING PRESS.

FERRACUTE MACHINE COMPANY, BRIDGETON, NEW JERSEY.

The coining presses illustrated on the opposite page are made by the above named company for the U. S. Mint, from designs by Mr. Oberlin Smith. These machines embrace a number of new improvements over those hitherto in use, so many indeed as to constitute an entirely new machine for coining purposes. The changes and improvements are pointed out in the following description furnished by the company :

"The toggles are placed near the bottom of the frame instead of the usual position at the top, and push the plunger upward, thus forcing the lower die against the coin, the upper die being stationary. One obvious advantage of this arrangement is that no oil or grease can get upon the coins, as all the moving parts requiring lubrication are below the plane of operation. Another advantage thus gained is the absence of lost motion, as the plunger and the different parts of the toggles are all held together by gravity, while in the case of top toggles, generally used, gravity tends to pull everything apart and cause a lost motion, which damages the dies and makes a rattling noise when running.

The joints of the toggles, with each other, and with the frame of the press, and with the plunger, are all arranged for rolling rather than sliding, the six working surfaces all being of hardened steel, and the bearings of unusually great length. Thus each toggle is itself a segment of roller, rolling against each other and against the adjustable plates above and below them, which take the same heavy pressures. The joints are all kept in perfect alignment by steel-cut gears and racks, arranged upon each side respectively. This construction is believed to be new, and is, among other things, being protected by patents covering the construction of the machine in general.

The upper die is fastened to an oscillating head, which can in a moment be swung forward and upward by means of the two handles seen in front of the machine, one of which unlocks the head and the other raises it. This allows unusual convenience of access for inspection and cleaning dies, an access which is generally obtained by an unnecessarily long stroke and the use of a mirror between the dies. In this case the stroke of the die is less than one eighth of an inch, which short stroke not only allows the coin to be confined so that it cannot accidently come out of place, but causes less wear upon the machine. Because of there being no noise the press can be operated considerably faster than usual, with a slower working speed of the dies.

The new form of feed is much more simple in construction. The coins are moved but a little more than their own diameter at each

stroke of the press, instead of five or six inches as has been customary. This conduces to speed, quietness and durability of running. The machine is provided with large and accurately-fitted bearing surfaces, convenient lubrication, accurate pressure adjustments, a swinging self-dumping cup for retaining coins while the receiving box is being changed, an adjustable shelf for holding such box, and a shield for covering the toggle. The arrangements for holding the dies, collar, feed tube, etc., are designed especially for convenience in adjusting and removing the different parts. The frame, plunger, ram, etc., are of massive construction, as will be seen by the drawing, which is one twelfth of real size.

In the maker's new system of classification this machine belongs to Class E, embossing and coining presses. It weighs about 4,500 pounds. Being of the second size it is called Press 'E 62.' It will coin gold, silver, and other metals, up to diameter of 1 inch, or more, at a rate of 100 to 150 per minute. The columns are 8 inches square, and the machine can be safely run at a working pressure of 150 tons. The company make similar presses two sizes larger, weighing 13,000 pounds, and working up to 400 tons pressure."

GAS ENGINE "LOGIC."

Prosessor A. B. W. Kennedy has been theorizing or reasoning deductively respecting gas and steam engines, in a late paper of his before the Royal Institution, in England, and reaches the following conclusions, that will have especial interest to the makers of gas engines on this Coast.

"In regard to the gas engine, its theoretical efficiency is already so high that there is but little need for attempting to raise it. The possibility of improvement lies in bringing the actual efficiency up to the theoretical, which is about 80 per cent. The greatest cause of loss is represented by heat taken from the water surrounding the cylinder. The fact is, we are trying to obtain incompatible results. To reach the high efficiency we make the initial temperature very high. But then, any such temperature would melt up our machines altogether, and we have, therefore, to adopt the somewhat barbarous expedient of continually keeping the metal cool by a current of water passing through a jacket. This water must, of necessity, pick up all the heat which can get through the metal, and carry it away to waste. The result is obvious in the figures. Although, therefore, the theoretical maximum efficiency is so much greater than that of a steam engine, the actual efficiency is not nearly so great. Notwithstanding this, the actual energy utilized per thermal unit of combustion of heat in a gas engine is very considerably greater than in a steam engine. Undoubtedly, great possibilities for increased economy exist here. A great help would be the discovery of some non-conducting material suitable for use in the construction of engines." * * * * * *

"Here, truly, is a field for economy, and one with very great possibilities. Aside from steam jacketing and other methods in partial mitigation of the waste, Prof. Kennedy states that there is no doubt that the great benefits which have been derived from superheating, and the still greater possibilities of economy which exist in it, and will probably soon be more heard of, are not at all connected only with the rise of maximum theoretical efficiency. The drying of the steam very largely influences its behavior under the conditions mentioned, and unquestionably helps enormously to diminish the waste. In the case of the incandescent electric lamp, to quote another instance of waste of energy, about 95 per cent. is expended in heat and only 5 per cent. in the actual production of light."

Following this is a good deal more, that we have no room to reprint, but the main suggestions are contained in the foregoing.

AMERICAN LOCOMOTIVES.

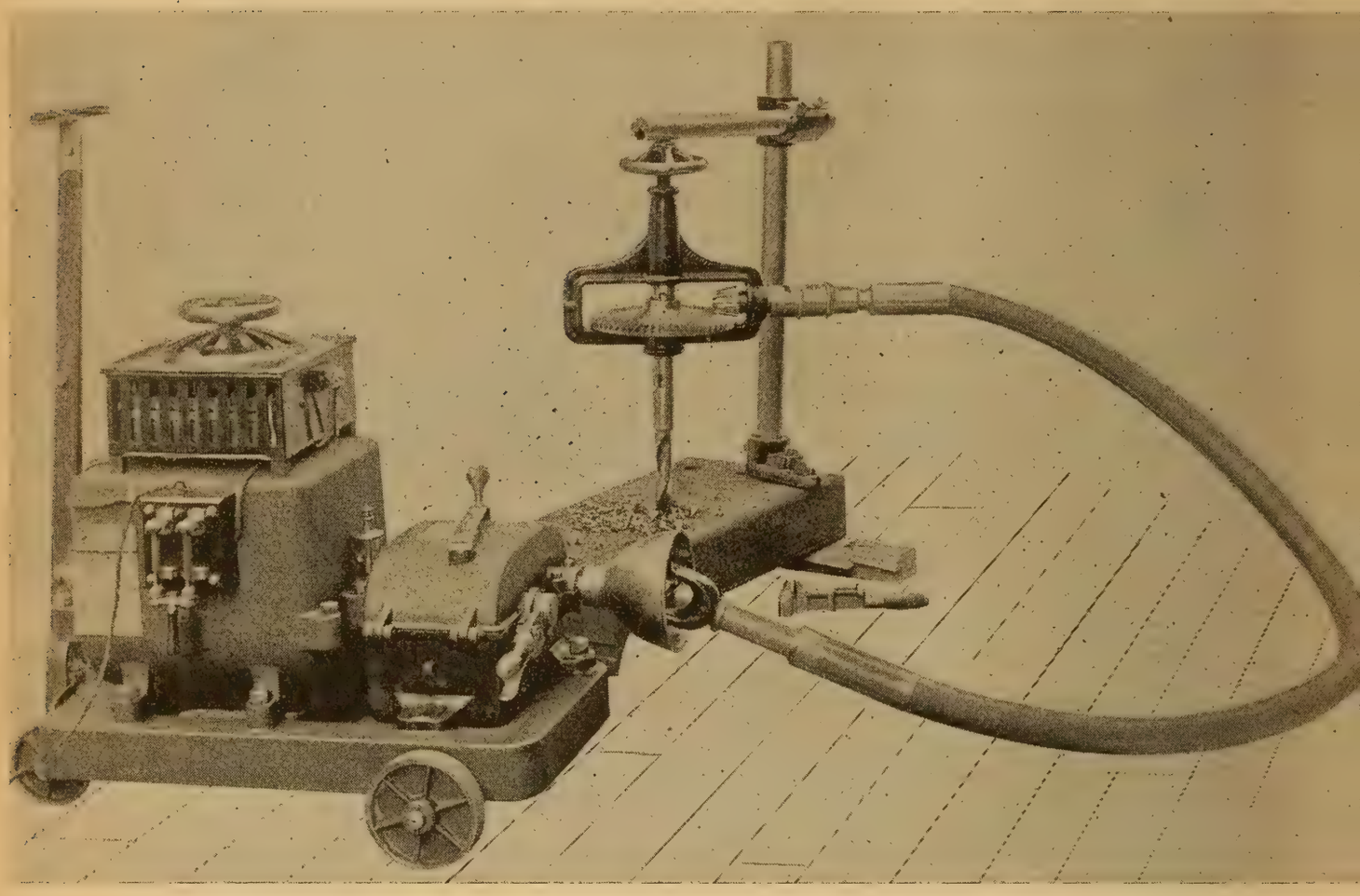
In *Locomotive Engineering* for August, there is the following remarkable account of an American Locomotive in England:

"In 1838 the Birmingham & Gloucester Railway was finished, and one part went up a hill with a gradient of 1 in 37, or nearly 143 feet to the mile. This grade was known as the Lickey incline. Such a grade was unprecedented in England for locomotives, and the most eminent engineers of the time, among them Brunel and the two Stephensons, expressed the opinion that it was impracticable to operate such a grade with locomotives.

Captain Moorson, who was chief engineer of the road, had heard about the extraordinary tractive power of American locomotives, and made up his mind to try one of them. He came to Philadelphia and returned with a Norris engine.

The day on which the trial of ascending the incline was to be made, a large crowd of spectators was there to witness the sight, many engineers and locomotive builders being present. The "Yankee," as the Norris engine was dubbed by the rival interests, went up the incline 2½ miles long, with a load of 34 long tons, at an average speed of 14½ miles an hour. Mr. Burry, the famous English locomotive builder, was present and delared that 'whatever American locomotives could do his could equal.' He went to Liverpool and brought one of his best engines. This engine without a train was permitted to make a run at the hill, but she failed to go up, and the builder brought her back amid the jeers and laughter of the crowd.

Owing to this triumph, the Birmingham & Gloucester Railway was equipped with Norris engines. The fame of this performance was the means of obtaining for Norris a contract to equip the Russian Government railways with locomotives, and the merit of American locomotives was established the world over."



PORTABLE ELECTRIC MOTOR FOR DRILLING, ETC.

GENERAL ELECTRIC COMPANY.

There have been several attempts to provide small portable electric engines or motors, especially for use in the erecting department of machine works, for operating, drilling, and like apparatus, besides a multitude of other uses where a small power is required in diverse places.

The General Electric Company, have turned their attention to this matter, and exhibited, at the late exhibition in Chicago, a very neat portable power apparatus as shown in the plate above, where its operation is illustrated by means of a drilling machine and flexible driving gearing.

The company send the following description of this motor or engine :

"The machine consists of a motor and a gear box mounted together on a truck, a flexible shaft, a drill press and drill rest. In addition, the motor carries on its side a double-pole switch, and on

top a starting rheostat. The motor is shunt wound, and has top poles, with one spool on the top of the field. The armature is of the Grasse ring type, and its shaft carries a pinion, serving to drive the flexible shaft through change and reduction gears, enclosed in a gear box, and running in oil or grease. A universal joint coupling connects the change gear shaft to the flexible shaft, which carries on the drill press and a clutch coupling which may be used for starting and stopping the drill. A second reduction in speed is obtained by the bevel gears driving the drill spindle. The drill press is held by a stand and arm, which may be clamped in any position.

Increase or decrease of speed is readily obtained by a movement of the side handle, and by another movement the intermediate gears are thrown in or out of mesh, when the upper lever slides the change gear into position.

This motor is rated at one horse power, and runs at 1000 revolutions, reduced at the drill spindle, according to the three positions of the change gears to 167, 83, and 12 revolutions. The machine is arranged for use with drills up to two inches in diameter."

MANUFACTURING MACHINE TOOLS.

Last summer one of our principal machine tool makers indulged in a protest against "special machines" that disturbed his "manufacture," and this brings to mind the fact that such business has become, in this country more than anywhere else, a "manufacture," also raises the question, if this is not a misfortune. The result is cheapness, and no more. It dispenses with skill, and whenever some special kind of machinery is wanted, as in the case of the water wheels at Niagara, we go abroad for it. There is continual importation of special machine tools going on.

We have a good many such here in San Francisco, and when special machines are wanted, the prices quoted in these "manufactories" are so high as to send the order abroad. We have seen quotations of prices as two to one for certain machine tools, and even a greater difference.

There are factories of machine tools abroad, in England and Germany for example, where merchant work is made for export, but machine shops there are not supplied with such tools. Some of the best makers in England, Messrs. Craven Brothers, of Manchester, for an example, never had an engraving of their tools, and, as we believe, no trade circulars. They photograph machines when completed, and send prints to accompany tenders, but there is no regular

manufacture of tools, or such uniformity as will permit engravings to be used.

The system in vogue in England, and, as we believe, in Europe generally, can be best illustrated by a typical case, that occurred about twelve years ago.

The writer, who was supplying certain machine tools for wood and iron, made in this country, was requested to call on a prominent locomotive superintendent, to receive instructions for a tender. "I want," said he, "a machine to bore holes in wood, and I observe that when there are to be holes of several sizes in one piece the augers must be changed and the work rehandled. I want a spindle for each auger, so that all the holes can be bored at one handling."

To have presented this officer with a trade catalogue of wood boring machines then in use would have availed nothing, except perhaps a courteous dismissal.

We saw at once the advantage of what he proposed, and knew also that no such machines were made at the time. Careful drawings were made for a multiple spindle machine and sent in with a specification. The result was a second invitation to call on the officer, when his remarks were in substance as follows: "Your proposed machine seems well arranged, as far as it goes, but its functions are confined to revolving the augers and moving them up and down. One man, or even a boy, can attend to this, but it requires a number of men to handle and present the timber so the augers can be set in position. Now is it not easier to move the augers laterally across the timber, and can you not assist by power the movement of the timber endwise?"

We had been designing one kind or another of wood boring machines for twenty years, and stood there before this officer, conscious of not knowing even the rudiments of what he wanted and required, but saw at once that he was correct, and a new machine was designed, with four spindles, all to traverse across the timber, and a self acting "roller bed" that would move the timber endwise."

The drawing was sent in with a specification, and in a short time came back the official order for the machine. It was constructed by Messrs. Bement & Son, now Bement & Miles, of Philadelphia, and cost about $800. This was the father, so to speak, of a numerous tribe that followed. Most of the leading makers in this country now make machines of the kind, which were, as above related, originally designed by Mr. Adams, of the London and Southwestern Railway, who furnished all the "ideas" of the modern multiple spindle

wood boring machine, now common in all countries.

We could illustrate the advantages of special practice by a number of instances of the same kind, where important improvments came about by a disregard of standard machines and machine "manufacture." It may cheapen machines, but does not improve them, in fact becomes a barrier to improvement, so there are at least two sides to the argument. It may be more comfortable and profitable to "manufacture" machine tools if people can be found to buy them, but it is not a very advanced method, or practicable with the highest class of customers who buy them.

One firm we know of engrave their machines in true elevation, to a scale of $\frac{1}{24}$, and have done so for twenty-five years past. This is a kind of compromise between the common trade circular plan and drawings, and has done very well, but calls for high skill in engraving to prevent a "flat" appearance. It is the old art of shading with India ink, now quite forgotten, and replaced by photography.

THE WEMBLEY PARK TOWER, LONDON.

It will be remembered that three years ago, when the Eiffel Tower, at Paris, engrossed so much attention that a tower company was organized in London, and, after some discussion, a design was accepted and the work commenced. The Wembley Park Tower is on the north side of London, situated on a small hill in Wembley Park, reached by the Metropolitan railway, and is a greater structure in every way than the Eiffel Tower. It will be 150 feet higher for one thing, and more symmetrical. The whole structure is to be of steel, and is now up to the first floor level, 146 feet from the ground, where the girders are 140 feet long and weigh 40 tons each.

The tower when complete will contain 7,000 tons of steel, and be 1,150 feet high. It will be a wonder of the world, made quietly, and without mention of any "person" out of whose wonderful intellect such a creation came. It is merely a plain engineering work, carried out in a systematic manner, and the only strange thing is that the money is risked in such an enterprise by the tower company.

The work is being done by Messrs. Heenan and Froude, of Manchester, a well-known firm who construct a great diversity of engineering work of one kind and another, and who, instead of 2,500 sheets of drawings as was required in the construction of the

Eiffel Tower, have most likely less than 250 sheets, and probably not 50 for the whole work.

As we intimated before in this Journal, it is no great feat to construct a high tower of steel. It is only unusual, calling for "strain sheets" of a peculiar kind. The principal feat, and the one calling for personal mention in connection with such a work, is the person, or persons, who furnish the money. This is, no doubt, the view taken in England, hence the absence of "fireworks" in the case.

Last year we pointed out in connection with the Eiffel Tower that its construction as a tower was a small matter compared to the cantilevers of the Forth Bridge, which were nearly twice as long, and projected out "horizontally." It would have been a great comfort, no doubt, to Messrs. Arrol & Co., the contractors, if they could have constructed the half spans of the Forth Bridge vertically as towers.

It is possible that in future towers may be built far beyond the present ones in height, if there appears any means of drawing revenue and profit from such structures. The limit is only one of money, or of profit. We have now the converse, shafts sunk into the earth more than twice as deep as the London tower will be in height. This immense vertical range in mines is traversed at high speed and in safety, showing conclusively that there is no difficulty in conducting traffic to the top of a tower 2,500 or even 3,000 feet high.

DAVID A. WELLS.

Mr. David A. Wells is the *bete noire* of the protection party in the United States. He is a stumbling block in their path, and comes in for those virile attacks born of self interest. He has had the audacity to show beyond mistake that the destruction of our merchant marine was the direct result of mistaken paternal legislation, and antiquated navigation laws, obsolete in other countries. He has also laid bare and made plain the causes that hinder our foreign and general trades, and to all this the only answer we have seen is to call Mr. Wells a *doctrinaire*.

In answer to this charge it will be honest to remember when, thirty years ago, our financial situation was desperate, not as now a paralysis of business only, but a struggle for existence. The National revenue was inadequate, and sinking under discredited

paper. It was then that Mr. Wells came to the rescue, and in an ably written essay on our finances, that was circulated in this country and Europe to the extent of 200,000 copies, revived confidence. He was at once called to Washington by Mr. Lincoln, who saw the cogency of the reasoning in *Our Burden and Our Strength.* Mr. Wells was put at the head of the National Revenue Commission, and soon had order out of chaos.

He found a tax of $2.00 per gallon on spirits, that made the distillers rich, and returned only $22,000,000 a year of revenue. This was changed to 50 cents a gallon, and at once produced a revenue of $56,000,000 a year, and in this circumstance can be traced the whole theory and fact of high taxes. Alcohol could not be used in the arts with a tax upon it of $2.00 per gallon. Substitutes such as naptha took its place, and it passed out of trade, except for chemical preparations. Under the new tax of 50 cents a gallon, alcohol again went into use, with the result named, an increase of 250 per cent. in revenue. There was no more drinking, as statistics will show.

Mr. Wells, in a pamphlet just issued, has again shown a way out of the present tangle in the revenue matters. He shows how the tax on malt liquors is only about twenty per cent., or one fifth of a cent on each glass. This produces a revenue of $32,000,000, which he maintains can be doubled and produce $64,000,000 without injury to any one.

Other suggestions we need not follow out; but one thing may be granted, that among practical American economists we have none that excel Mr. Wells in so far as an understanding of the nature and sources of revenue, and it is now a good time to again call in his counsels.

A STEAMBOAT YARN.

The clerk on Mississippi steamers of olden time was the aristocrat of the "staff." He was purser and administrative chief within the office and cabin, dressed in the latest style, and with an exaggerated opinion of his importance. These remarks apply especially to the second clerk, who usually out-vied his chief in fashion and pretense.

There is a story told of the second clerk of the *Eclipse*, a wonderful boat of forty years ago, that has its main traditions in Mark

Twain's river stories. The clerk was by rank of the steamer a man of high position, for the *Eclipse* was the greatest boat on the river in her youthful days, besides his personality was of the assertive kind.

On one of the early down trips of the *Eclipse*, from Louisville to New Orleans, the mate shipped a deck hand by the name of Paddy McCue, a kind of wag, a bright little fellow, Irishman by trade, full of wit, and with impudence enough to furnish a watch if not a whole crew.

He noted the strutting second clerk, who had made himself objectionable to the whole main deck, including even the captain, and especially the mates, whose prerogative had been interfered with by the clerk, who had to come down and "check off" in receiving and discharging freight at way landings, and in addition had, in violation of steamboat law, "spoken to the men" who were handling.

Paddy had been addressed by the clerk relative to something he was handling. His ire was up at once, and he reported to the mate, saying that if not discharged for the offense he would "fix the clark." The mate told him to "fix away."

The steamer was nearing Hichman, Miss., and the clerk came down with his portfolio, a plug hat, and a Havana cigar, the personification of importance, and started aft on the port guard with the air of a field marshal. Paddy McCue met him half way, and thus addressed him :

"I say cook, are you the captain? You look so much like the steward I thought you was the mate."

Hidden around the boilers, in the cookhouse, and elsewhere, was the whole watch to see the fun. The mate and engineers, who were in the joke, were also within hearing.

The clerk was at first dumbfounded, then enraged, and roared out : "What do you want, you impudent rascal?"

Paddy replied in the coolest manner: "O sir, I only wanted to borrow a pick-axe to saw an empty barrel of flour in two to make my pig a hen coop."

The roar of laughter that followed drowned the noise of the engines, and the thunder of the wheels. It went echoing out and back from the dense cane brakes on the near shore, followed by other noises of a diabolical nature.

The poor clerk stood like one in a stupor, fixed to the deck. Finally he retreated up the companion way.

RAILWAY TO CENTRAL AND SOUTH AMERICA.

Mr. W. D. Kelley, treats in the August number of the *Cosmopolitan Magazine*, of an inter-continental railway between North and South America, and gives some account of the work of the engineer corps operating in their divisions, detailed from the U. S. Army to survey or reconnoitre routes for a railway from Mexico to various South American cities.

In previous notices of this scheme we have ventured to call it economical quackery. A view somewhat confirmed by Mr. Kelley's article, which indicates attention given to the scenery and the customs and the character of the people, rather than to technical matters connected with a railway.

A glance at a map will show that water lines are shorter than a rail route can be, and as steam vessels can be moved at a higher rate of speed than railway trains are likely to be driven at in that country, under circumstances of greater comfort and safety, and at one fifth the cost, the question arises, what would such a railway be for?

It would be exposed to the various political exigencies of Central and South American States, dangerous from a variety of causes, and, as we believe, almost impossible to construct. In fact, if made now and complete, such a railway could not be accepted as a free gift by intelligent capitalists of any country, on condition that they would operate it.

It is not long ago when comparisons were made between railway and water carriage from Toledo to Chicago, the land line being 200 miles and the water line 700 miles long, with the result that the cost of moving freight was about the same, by either route. In this case, however, the comparison was not fair in respect to vessels. They have to sail to nearly all points of the compass, be towed through the St. Clair River, and work their way through Mackinaw Straits. So the 700 miles was more than equal to 1,000 miles at sea on an open course, such as exists between New York and the Atlantic ports of Central America, or to Rio de Janeiro and Buenos Ayres.

The scheme, in any phase it can be considered, is impracticable commercially, and is no doubt so physically, if not politically—a freak of sentiment not supported by one sober view of the actual conditions.

The harm done by these wild schemes is to destroy confidence in meritorious and possible undertakings. For example, who without

technical knowledge can draw a distinction between the Nicaragua Canal and the inter-continental railway? One will destroy the other. If men will project a railway longer than a sea course to connect two countries, through lands where good engineers contend a railway cannot be maintained, why will not the same men plan a canal equally impossible? This is the course of reasoning in these matters, felt, if not expressed. Mr. Kelley, toward the end of his article, offers some suggestions as to commerce that will be new to many of our readers. We select a few paragraphs in illustration.

"Our engineer corps had purchased field instruments of a leading firm in New York City at a price twenty per cent. greater than we could have bought the same instruments, by the same firm, had we ordered them from South America. An equipment of rifles and side arms, even with the discount allowed us in New York City, would not bring as much after we had carried them to South America. The same thing applies to sewing machines and calicoes especially, and almost all manufactured articles in general. Naturally a manufacturer who can sell his goods at home for twenty per cent. more than he can elsewhere, does not care to cater to other trade, even though he may make a fair profit on outside trade.

Railroads and steamship lines stimulate trade when people are desirous of trading with one another. If that desire does not exist, then no amount of communication between them or even the locking of them up in the same room can make them trade. As in "swapping jack-knives," it takes two people to make a bargain."

Here in the first paragraph is a problem for serious consideration. Why should people sell abroad when they can force their own countrymen to purchase the goods at a higher price. It is a well known impediment to foreign trade expressed in a new way.

Our interest in Central and South America does not lie in railways, but in a removal of trade barriers and the establishment of ocean lines to ports in these countries, and the expenses of this survey by the U. S. Engineer Corps may be safely charged up to a profit and loss account.

A NEW FEATURE IN LOGGING OPERATIONS.

During some years past there have been made here a number of small warping machines for hauling logs out of cañons and inaccessible places by means of a winch with a steam engine and boiler, self-contained and portable to the extent of being shifted from place to

place. Now the scheme has been extended to what may be considered a "system of transportation."

The Vulcan Iron Works, in this City, has just completed a warping engine of 35 horse power, with wire cables to reach a mile, and provided with overhaul ropes of small size to haul out the main cables. The machine is intended to be placed in a cañon or near the mouths of ravines or gulches and is double, so that trains of logs can be hauled in from two directions at the same time from any point up to a mile each way.

The machine, which we examined, is massive, built on double channel beams 12 inches deep. The drums, three in number, are of iron, mounted on powerful shafts, the whole braced and bolted in the most substantial manner.

The outhaul movement will be at the rate of 300 to 500 feet per minute, and the inhaul or log train at the rate of 175 to 250 feet per minute, bringing in a train of logs tandem, as many as can be safely linked together. Angles are made by means of snatch blocks, so the course can be as crooked as the ground requires.

A system of mechanical telegraphing is provided, so as to communicate with the engineer from any point. The "pull" is 9 to 13 tons, and the saving over hauling with teams, and the expense of making roads for that purpose, is estimated at ten per cent. on the finished product of the saw mills. Farther particulars of these machines can be procured from the Vulcan Iron Works, where they have been designed and are made.

Mr. A. D. Pentz, in the section on Machine Shop Practice in the *Engineering Magazine* for November, complains of sockets to hold machine drills, and with reason, but he is wrong in assuming there are no good "chucks" of the kind. We once made a drilling machine, not a "press," for Mr. Wilson, of the Southern Pacific Railway Company, provided with sockets to receive shanks not less than one inch in diameter, the socket portion slightly tapered, flattened on one side to receive a through key mortised through at one side of the bore. The sockets fitted into the spindle in the same manner with a diameter of one and one half inches or more. The machine has been in use eight years, and we much doubt if ever there has been a failure of its sockets or of the drill shanks. Size is the main thing. If it were not for expense the square shanks of our forefathers are the best of all.

LONDON FOG.

I will never forget the first fog I saw in London, not only saw but felt, because a fog there is not a spectacular performance alone, it is a grand choking fact. In the first place the word "fog" as we use it in this country means water mist, and that only, but in England the term includes whatever obscures vision, consequently London smoke, which is the principal ingredient in what is called "fog" there.

I was living in lodgings in a narrow street near Lincoln's Inn Fields, and had seen a good deal of London during the summer, now was waiting for the chief winter feature—a fog. It came one morning about 9 o'clock. I was engaged in writing and noticed some unusual sounds in the street, which called me to the window to look out. There was nothing but a green sea below, the street was filling up just as a tank fills with water, higher and higher it came until it reached to the window. I opened that and the fog poured in. Closing the window I went down into the street, and at last was in a "London fog."

The street lamps were lighted, but were of no use. They could not be seen more than ten feet, and then seemed like a ball of dull red fire emitting no light. Feeling my way along the walls I went out to Holborn Street, a hundred feet away. The people were moving there, feeling their way, not many however. You could hear umbrellas and canes raking on the houses, people searching their course by this expedient.

Inhaling the mixture caused a sharp smarting sensation, and one's eyes became dimmed by water. It was wierd, curious and "deucedly uncomfortable," as the host at an inn said where I went for a glass of ale. The fog lasted three days, and cost half a million sterling, as one man informed me, but he was no doubt mistaken.

London fogs we hear of, and certainly London is a chief center, because of three million chimney pots there, but the fogs are all over sometimes. I have seen in Birmingham, Sheffield and Manchester much the same kind of fogs, when the whole country was obscured for days, and the sound of signal torpedoes on the railways could be heard continually.

There is a science of these fogs no doubt, but I have never studied it, so am prepared with a theory of my own. It is this, the air pressure falls and evaporation from the earth ceases to rises. The smoke from chimneys pours out on the roofs, and rolls off

down to the ground, and the city is filled up. The smoke is one of the first symptoms of a fog, which is thickest in damp and low places, also thickest where there is much smoke.

Cab fares are chaotic, the city ordinances do not apply. "Hi there, drive me up to the Circus," cries an Englisman. "Three bob," says Cabby. He well knows he has a native to deal with. The "Circuses" are circular plazas in London, many of them in various parts. Another hail will be: "Say, how far is it to Bedford Square?" Here is Cabby's chance, it is a stranger and an American. "I don't know," says Cabby, "a dozen turns or so." "How much to take me there?" comes next, with the answer "ten shillings." Cabby drives on, is called back, takes up his fare, and drives around the same block a few times, and dumps the fare a hundred yards from where started, ten doors from his lodging place.

The boats on the river have to stop. Omnibuses stop, in fact nearly everything stops, it is a calamity. You meet people with respirators over their mouths. A kind of black patch pervious to air, but close enough to strain out the smoke and soot.

The old Londoner is rather proud of his fogs, and does not complain. He can keep the fog out, but an east wind collapses him, so to speak, and no wonder. He can explain how these winds come across the Steppes of Tartary, blasting the country all the way from Asia to his front door. The east wind there is one without moisture, just the same, but not as dry I imagine as the winds that cross the sand deserts of California and Arizona, that suck up the water from Salt Lake at a rate of half an inch daily, and destroy all life to the windward of the water.

In England the east wind blasts vegetation, brings out rheumatism and every kind of ailment ever heard of, and some peculiar to the phenomenon. The fog is nothing in comparison. What little creeps into houses is at once drawn up the chimneys through the open fires. Heat and dryness dissipate it at once, and one can remain indoors with comfort.

At Islington, in November, is held a cattle show, a kind of agricultural fair for the exhibition of cattle and animals mainly, but also of other things, and it often happens that the fogs come on, that being the season for them. The country folk are dismayed in such case, and the cabmen reap a harvest. How these men find their way in a fog no one has ever discovered. They go on just the same, slower of course, but, in the slang of the day, they "get there" somehow.

THE TECHNICAL SOCIETY OF THE PACIFIC COAST.

This Association met on the 3d of November, at their hall, 819 Market Street, at 8:30 P. M.

Mr. F. E. Trask, of Ontario, was elected to membership, and two new applications were received.

Mr. D. C. Henny, the Society's delegate to the recent Irrigation Congress at Los Angeles, Cal., submitted a report, of which the following is an abridgement:

"Technical papers were read by—

F. H. Newell, on "Irrigation Investigation of the U. S. Geological Survey;"

Don José Ramon Ybarrola, on "Irrigation and Other Public Works in Mexico;"

L. W. Allingham, on "Sun Heat as a Source of Power for Irrigation Purposes;"

C. Comodzinsky, on "Irrigation and Drainage in the Russian Empire;"

C. R. Rockwood, on "Some Mistakes in the Development of Irrigation Enterprises;" also on "Irrigation of the Colorado Desert;"

Robert Stanton, on "The Cañon of the Colorado;"

Leon Phillippe, on "Irrigation in France;"

A. P. Davis, on "Economy in the Use of Water."

Considering the method of electing delegates, the number of engineers accredited to the Congress was large, and it is a significant fact that all delegates from foreign countries were engineers. Each of the States represented, selected one vice-president and one member on the Committee on Resolutions, and after a motion to that effect was carried, the members of the American Society of Irrigation Engineers, and the delegates from Engineering Societies, selected an additional vice-president and member of the Committee on Resolutions. Jas. D. Schuyler serving in the former, and Wm. Hammond Hall in the latter capacity.

One of the most striking speeches made at the Congress, and which called forth no small amount of controversy, was that of J. W. Powell, of the Interior Department of the United States, which is herewith inserted, as reported next day in the *Los Angeles Times*.

"He said he had grown to be an old man while seeing the wonderful development of the country. He was not so much interested in the great railways and extensive public works, valuable as they

were, as he was in the development of a great number of homes for the people. He was more interested in the home and in the cradle than in the bank counter.

The water that fell on the land, a large extent being considered, fell unevenly. In some places there was a great maximum, while in others a minimum. In the valley of the Potomac there was an annual rainfall of forty inches. About half of this was re-evaporated and the remainder was carried off by the streams and rivers into the sea. As one came westward there was a lesser proportion carried into the streams in a constantly decreasing ratio, as the stream was considered. In a large portion of the plains the local 'run off,' as it was called, was sufficient to irrigate if it were only stored at the proper places. There was but a small part of the irrigable land that could be irrigated if all the water that could be were used for such purposes. If all the water needed were utilized for the lands now belonging to private individuals there would be none left to use for the lands belonging to the Government.

The lands remaining in the hands of the Government were valuable for stock-raising, for mining and for forestry. In his judgment there should be no more of the Government lands used for irrigation purposes, except in a comparatively few places.

He said in reference to the lack of water, that he believed when the number of inches of annual rainfall per acre in the great arid region was compared with the amount of water needed per acre for irrigation, his statement would be found to be true.

Colonel Hinton of New Mexico said that such statements as these, coming from a man holding the official authority that Major Powell did, and going out to all the world through the points of the pencils (indicating the reporters) meant a black eye to irrigation.

Major Powell, in continuing, said that from a local standpoint there was enough water for irrigation, but making the statement a general one, he felt that he was right in stating that there was, in the arid region of the country as a whole, only enough water to irrigate the lands at present owned by private individuals, without extending the irrigation to the lands now owned by the Government. He said he considered carefully as to whether or not he should make such a statement at this Congress. He felt, however, that it was his duty to do so, for if further Government lands were ceded to private individuals for irrigation purposes there would then not be water enough to go around, and an endless heritage of litigation would be the result.''

The Congress finished its work by adopting a platform, in the shape of an address to the people of the United States, in which attention is called to the over-shadowing importance of irrigation to the West. The salient features of the address are in respect to cession of the public domain in the arid region to the individual States, and the thorough indorsing of the California Wright Act as a wise step in the direction of public ownership of irrigation works.

The framing of National laws is urged to prevent disputes between States regarding the right to water, and all States in the arid region are advised to make provision for departments of irrigation, supervision and engineering.

In addition to this platform, a number of resolutions were adopted, of which the following may be of interest:

"We advise each State which embraces any part of the arid domain, and which has not already provided for irrigation, supervision and engineering, to do so at its next legislative session, and to vigorously prosecute the work of investigating the extent to which further irrigation can be carried on with success and profit."

After the final adjournment of the Congress, the California delegation met, and decided upon the organization of a State Irrigation Association, and the early assembling of a State Convention, in which it was voted that each county should be empowered to send two delegates, and each irrigation district, irrigation company, university, and the Technical Society of the Pacific Coast, one delegate. The completion of details and the arrangements for a convention were left in the hands of an executive committee.

The proceedings of the Congress will be printed in full at an early date, and your delegate has made a request for a number of copies to be sent to this Society. D. C. HENNY.

A discussion was then opened on the subject of Mr. Henny's paper, read at the last regular meeting, entitled "Supports Required for Curves in Pressure Pipes." The author explained the proposition to the members, and the President began the discussion by a general treatment of the subject, after which a number of the members participated. The paper and discussion are published in the "Transactions."

At the next regular meeting, Dec. 1st, Mr. G. W. Dickie, Manager of the Union Iron Works, will deliver an address upon his observations at the Columbian Exhibition. This will be a most interesting and instructive contribution, and should call out a large attendance.

REPORT ON THE SAN FRANCISCO SEWER SYSTEM.

The report of engineers, Messrs. Manson and Grunsky, appointed to devise and provide a system of sewerage for San Francisco, has been published and a copy sent to the editor of this Journal.

The report is both compendious and comprehensive. It sets forth the official acts creating the Commission, and those of the Commission itself, ably and conscientiously; but will not be pleasant reading, because the technical, scientific and sanitary features will at first be overlooked to dwell in amazement on the wanton and inefficient administration of the sewer fund in the past, exceeding, as it does, by far anything that inference can assign to a department known to be one of the worst among others that are bad.

The crowded condition of our columns this month, and lack of time to examine the report fully, must confine our remarks to a single feature. Next month a more extended notice will be given.

The feature referred to will be found on page 77 of the report, where is given, in conjunction with a diagram of the annual rain fall in this City, a curve showing the death rate from what are called "filth diseases." We select this subject at the present time because it is one that must appeal to public opinion in the strongest manner, also appeals to humanity and the sense of self preservation from infection.

In December and January, when the maximum rainfall takes place, and the volume of storm water is sufficient to flush and cleanse the sewers, the rate of deaths from filth diseases descends rapidly from 75 to 50 per month. Then, as the volume of storm water weakens in April, and is no longer capable of dislodging solids from the sewers, the death rate rises gradually through the dry months, reaching a maximum of 78 for November.

A glance at the diagram shows unmistakably the correlation between this effect of storm flushing and the rate of deaths from diseases engendered by mephitic gases, nor is this the only evidence of imperfection in the sewage system. A table by wards further confirms the extent of danger in proportion as the sewers are faulty.

The wholesome effect of storm water is baffled and impaired by imperfections of construction that must be seen to be believed. This is to some extent shown in the report by photographs taken from underground work, and hence indisputable faults of plans, inspection and execution that must go down as a shameful record for this City.

A SMOKING ROOM DIALOGUE.

MR. WISEMAN (a book learned man who had been reading Wendell Philip's lectures on the "Lost Arts") *Loq.*

"I tell you we don't know half as much as we think we do, and less than the ancients in some things. Look at the pyramids in Egypt. We could not raise and place those stones with our present puny tackle. Then there are the ruins of Carnac and the quarried stones in Central America as big as this ship, what could we do with them at this day? Could we chisel out a Sphinx with modern tools from hard granite, or build the Tower of Babel?"

The listeners are abashed, and wondered at what Mr. Wiseman said except a bristly Scotchman with a fifteen shilling suit of tweed, brogans, and a black pipe, who was watching and smoking.

DUNCAN DOUGLAS (the Scotchman) *Loq.* —"Mr. Wiseman, are you an engineer?"

"No."

"Then how the die'l do you know these things cannot be done at this day?"

"Oh! I assume that as a matter of common knowledge. Everyone knows that."

MR. DOUGLAS.—"You assume it do you? Well a countryman of mine, Mr Rankine, you may have heard of him, says all the great pyramids of Gizah, could be raised and placed with as much coal as this steamer burns in two days. What do you know about that? As to stones at Carnac and elsewhere, you don't know if we could move them or not. It is a question of wages or the cost of power. When Mr. Layard had the big bulls of Ninevah dragged down to the sea, he had rawhide ropes made, nine inches in circumference, and the promise of some food and tawdry clothing, supplied man power enough to drag the bulls in the sand, cutting a furrow four feet deep behind them. That is a fair specimen of your ancient engineering feats. History shows that 'man motive power' cost little or nothing in Egypt and other places when this kind of work was done. It was brute strength, so cheap that quantity did not matter.

Now if you or anyone else is prepared to pay the bill, I will find a contractor who will move the greatest pyramid of Gizah, over to the Nile and dump it in, without taking down a stone. You had better confine your lectures to what you understand."

GENERAL CHORUS.—"Scotchman go up head! Smoke room steward!—Hot Scotch, all-round!"

A PROBLEM OF GRAMMAR.

The present clamor that fills the columns of the newspapers on this Coast respecting the deportation of the Chinese in the midst of a national business calamity such as now exists, calls to mind a story of the American Civil War, told of General Ammen. It will answer as an illustration.

Gen. B. C. Tilghman, of Philadelphia, then a colonel in nominal rank, by some exigency, or more likely because of his administrative ability, was, for a time, put in command of the Department of Florida. In due time General Ammen was assigned to this command, and appeared to rceeive the records and business of the department. The General was an officer of punctillio, exactness, a scholar, and had a horror of bad grammar.

Among the records was the finding of a court martial condemning a man to be "hung" on some near-approaching day for murder. The General looked over this decree, and at once called attention to the matter. "Here," said he, "Colonel, how is this? A man to be 'hung' at a certain date. Why this is all wrong."

General Tilghman explained the circumstances of the crime, and of the trial, and insisted that all was regular and in accordance with the rules of war.

"But," said General Ammen, "that is all right, but the man must be 'hanged' not 'hung.'" With an apology to General Ammen if yet living, and supposing the story is correctly told, we think the circumstance fairly represents the status of the "Geary Act" just now.

Congress was assembled in extraordinary session to, in some manner, relieve the distrust and disaster in the financial and commercial affairs of the country, and have instead spent most of the time in a contention over personal interests and the deportation of Chinese, the latter amounting in relative national importance to about the same as the tense of the verb that General Ammen objected to.

The speeches on financial problems, long, frothy and meaningless in most cases, are worthy of the memorable critique of Charles Francis Adams, Senior, in the *North American Review*, which we will quote at some future time when "things are more settled."

LITERATURE.

Consular Reports, No. 156.

SEPTEMBER 1893.

In this number Mr. G. T. Baggs, U. S. Commercial Agent at New South Wales, communicates a lengthy paper on the present and past financial panic in the Australian colonies. This paper furnishes another evidence of the absence of anything in commerce or economics that can be called a "science." There is no use of going over statistics. They are well known, but when a colony of hard-headed English people, guided in some measure by the counsels of old and wise heads, go off into a speculative state that defies history, and all the recognized principles of economics, what security is there for the future?

Consul General Mason, at Frankfort, Germany, writes of the opportunity offered to this country in supplanting Russia in the grain trade to Germany. This matter we discussed briefly in our last issue, giving the principal figures in the case. It is a matter much affecting this Coast. The Consul General says:

"It will be noticed that the imports from Germany into Russia have been hitherto largely manufactured goods, whereas German imports from Russia have been principally of the nature of raw materials. The import duties on most of them are already so high in both countries that a 50 per cent. increase will be practically prohibitory, provided the supplies which each has hitherto imported from the other can be reasonably obtained elsewhere. Here, then, is a new and timely opportunity which American producers and exporters will assuredly not fail to study and improve."

REPORT NO. 157, OCTOBER 1893.

In this number is given further and more extensive accounts of the tariff war between Germany and Russia by various Consular officers. Such a contest is quite as imbecile as a war with arms, but less cruel, and a thousand times preferable to cutting throats, so that if it ends without bloodshed all praise should be given to the system.

Some of the German tariff rates are as follows: Wheat, rye and oats 7.50 marks per kilogram. The kilo is 2.2 pounds, and the mark about 24 cents, so the tax is about $1.22 per 100 pounds, or 20 per cent. more than wheat is worth here in California. Hay and straw are prohibited except from certain districts, because of danger of disease to animals.

Germany imports annually 50 to 60 thousand tons of raw flax, nearly all of it coming from Russia. It is expected that Russia will impose an export duty on flax, and if so this country should avail itself of this market. Flax can be grown in endless quantity in the Eastern States.

The main feature ot the present number is a report on technical and training schools in Europe. We have no space in which to produce but a few of the facts given, and must refer our readers to the Report. It is amazing in respect to Germany, Sweden and Switzerland, also some other countries. Russia has manual training in 116 schools. In Sweden, with four and a half millions of population, there are 1,600 such schools. In Switzerland the Government gives aid to 157 technical and training schools, in which there are 17,000 pupils. The question arises where are these people to apply their education unless it be as mechanics. They swarm all over the world, and in this country have captured the greater part of such work as their education fits them for.

Advance Sheets Consular Reports.

NOVEMBER 1893.

U. S. Commercial Agent Griffin, at Linoges, France, writes to the State Department respecting what he calls American groceries in France, meaning thereby packed food, such as meat, fish, fruits and vegetable, and it is surprising what a large share of California products figure in his suggestions. The great fact in California's interests is the want of means to present her products for sale in foreign markets without half or more of their value being absorbed by middle men. California raisins, says the agent, are preferred to every kind, and canned fruit, especially peas, are sought for, also other

canned fruit of all kinds, with fish, and whatever can be eaten without being again cooked.

Consul General Mason, at Frankfort, writes of gas motors in Germany, and gives the price of gas in eleven German cities, the average of which is $1.16 per 1,000 feet, which for a country almost without coal is a comment on our own prices. This low price in Germany is due, the Consul says, in a great measure to the skill and care exercised in saving the bye-products, such as tar, ammonia, etc.

The International Naval Rendezvous and Review of 1893.

This document, issued by the Office of Naval Intelligence, Washington, contains a wonderful amount of information of a technical character, with a full account of the Columbian Naval Review, at New York, in April, in which most of the countries of the world participated. It was due to this circumstance, and the account of it, that the Naval Intelligence Office issue a report for this year. The contents are too voluminous for further notice at this time, but will form the subject of some notes in future numbers.

Transactions of the American Institute of Electrical Engineers.

RALPH W. POPE, SEC'Y, NEW YORK.

We have on former occasions commented upon the scientific rank and value of the proceedings of this association. It is meet that in the latest and most comprehensive branch of applied science, one born in an age of learning, and has brought to bear from the beginning the efforts of the most able among scientific men, should send out into the world a worthy record of works.

The present bulletin, for August and September, 1893, contains three papers of much interest, because consisting mainly of novel and advanced matter. One by D. McFarlan Moore on "A New Method of Controlling Electric Energy;" one by Mr. Parkhurst, a rejoinder answering discussions of a former paper of his, on "Galvanometers," and a communication from Mr. L. B. Stillwell, a discussion of Dr. Envery's late paper on "The Cost of Steam and Water Power."

Dynamo Machinery and Allied Subjects.

BY PROF. JOHN HOPKINSON.

By glancing over this small treatise, which is all that one can find time to do, and being guided by such inferences as come to a person not skilled in the electric arts, we are of the opinion that the present book is the best explanation of dynamo machinery that has appeared. In this estimate we take into account compendious treatment, such as comes within 250 pages, 12 mo. with copious drawings and diagrams. The subject is treated in an advanced form, but under elementary arrangement, and the characteristic feature of the book is the evidence everywhere of the author's mastery over the matters dealt with.

The W. J. Johnston Company, New York; Osborn & Alexander, San Francisco, price $1.00.

The Religion of Science.

BY DR. PAUL CARUS.

If the struggle for existence permitted us the time, we would go out into the "red woods" and sit down to read this book. The warrant of Dr. Carus, and we may link the publisher's name as well, gives warrant of wholessome thoughtful reading here. The Open Court Company have distinguished their productions by typographical dress that has never been excelled if equaled to this time, and it is deserved praise to say the subject matter put forth is worthy of the dress.

In the present and other publications of this Company can be seen a foreshadowing of a higher intellectual plane, and a closer relation of human interests and wants, moral and physical. A list of these publications will be sent by application to the Company at 169 La Salle Street, Chicago. Price of the book above named 50 cents. The Open Court Publishing Company, Chicago.

Table Book.

BY G. W. PLYMPTON.

This little book, which externally presents the appearance of a rudimentary series, will on examination be found something quite different, a kind of "implement" in technical and commercial business, anticipating, for one thing, the evidently approaching metrical system of notation. There are

tables converting English measures to metrical, also the equivalents the other way, from metrical to English measures, from one to a hundred. This portion of the book is its most valuable part, and the present copy is assigned a convenient place at our elbow.

D. Van Nostrand & Co., N. Y.; Osborn & Alexander, San Francisco. Price 50 cents.

Venturi Water Meter.

In our last issue we mentioned a large water meter made by the Builders' Iron Foundry, at Providence, R. I., to measure the drinking water consumed at the Chicago Exposition, and have now received from the Company a treatise of 60 pages on the Venturi system of meters that is of much technical interest, and, no doubt, of practical interest too, on this Coast, where measuring water is a matter of great importance. The principle on which these meters act was discovered by the Italian philosopher Venturi nearly 100 years ago. The following explanation we quote from the pamphlet:

"The action of the tube is based on that property of the Venturi ajutage which causes the small section of a gently-expanding frustum of a cone to receive, without material resultant loss of head, as much water at the smallest diameter as is discharged at the large end; and on that further property, which causes the pressure of the water flowing through the throat to be be less by virtue of its greater velocity, than the pressure at the up-stream end of the tube, each pressure being at the same time a function of the velocity at that point, and of the hydrostatic pressure which would obtain were the water motionless within the pipe."

The meters are adapted to a large flow of water, and contain no mechanism to be deranged. The results seem anomalous, but a long paper by Mr. Clemens Herschel, here reprinted, contains an elaboration of tests and computations that show very conclusively the correctness of the readings. We expect to again refer to this matter and recommend that it be examined by our hydraulic engineers.

Triple and Quadruple Expansion Engines and Boilers.

BY A. RITCHIE LEASK.

In the case of this book we will adopt the lazy expedient of quoting from the author's preface as follows:

"This work has been written to meet a widely-expressed desire for information regarding the management of triple and quadruple expansion engines and boilers, and the Author has endeavored to produce a book that would, in plain every-day language, place before engineers a digest of the experience of those who have been in charge of machinery of the above description, together with such rules and directions as may have been suggested by these experiences, in addition to a popular description of the more prominent inventions and appliances that have been recently adopted in connection with such machinery."

The work is crammed full of hints and instructions of value, answering the hundreds of questions that a steam engineer would be expected to ask in mastering his business and in describing what he should know.

The book is profusely illustrated, contains 250 pages, and is sold for $2.00. Tower Publishing Company, London; Osborn & Alexander, San Francisco.

LOCAL NOTES.

At the time of our going to press, the trial trips made by the U. S. Cruiser *Olympia* will go far to prove a conceit on this Coast that the Union Iron Works have done the best work bestowed on our new war vessels. The speed recorded is phenomenal, and should it equal that of the *Columbia*, as is expected, the result can be set down to a careful attention to the details of her motive power. The designs and plans are furnished by the Government, but there are a good many ways of carrying them out. A good deal is left to the supervising engineers and contractors, subject, of course, when of importance, to approval by the Department, but still the fact remains that there are a good many ways of building a ship. The weather at this date portends a postponement of the speed trial set for the 27th of November. The rate, as reported, for the run on the 25th was 22.2 knots for the whole course. That of the *Columbia* with about 50 per cent. more power was 22.8 knots. The requirement for the *Olympia* is 20 knots, with a premium of $50,000 for each quarter knot in excess.

We claim the privilege, with almost everyone else, of knowing just how the *New York* could have been saved. There was wide divergence of opinions, but there will certainly be an accord of views respecting the salvage appliances and skill at this port. The kind of skill, knowledge, or intuition, or whatever it is, that enables men to grapple with such emergencies, is not a common quality. Not one in five thousand are qualified for such a work, and that person is commonly not available. Previous experience pertains mainly to methods, after a course of proceeding is decided upon. The vessel had to be raised to clear the projecting points of the rock, but as soon as she was buoyant the swell began new destruction of her bottom. Perhaps there was no way to have saved her. No one can determine except those who knew "just how to get her off." At present there is no hope of anything except more careful navigation in the heads, which can certainly be expected.

The Union Iron Works had their usual good fortune in launching the *Oregon*, last month, and but few people suspect the care,

anxiety, risk, and expense of such launches. It is a distinct event in the creation of a great ship, calling for independent calculations, a special outfit, and an amount of skill acquired through a long experience of hundreds or even thousands of years in the past. The slightest miscalculation and accident means disaster. The deflection of a few inches in the ways as the monstrous weight passes over them, would strain a ship and set up dangerous conditions not easily remedied. At the Potrero, launching ways have to be supported on piling reaching down 40 to 60 feet into the mud, gaining their stability from friction, and as the load on them and what they will bear are both problems of uncertainty or contingent upon uncertainties, launching is a time of suspense for the builders and all concerned, weeks of preparation have reference to an event of less than a minute's duration.

A bill has been introduced in Congress by one of the Congressmen from California, calling for the establishment of an ordnance factory or arsenal at Benicia. It is not very likely that the War Department will concur in or approve of any bill of the kind, emanating from Congressmen who want a gun factory in "their district." Such an establishment is a National affair, and its site should be selected by responsible army officers and not made what is called a political job. The row raised two years ago by Senator Dolph, of Oregon, and others, over this same matter of a gun factory on this Coast, was no doubt the cause of no site being chosen there. It is well enough for Congressman Caminetti, as a citizen, and others, to present the claims and advantages of particular sites for such a works when such representation does not have the appearance of a scheme for constituents. There is no question as to the very suitable nature of the Government lands at Benicia for such a works, and it would no doubt be chosen by a proper commission of the War Department, but a specific bill emanating from a Congressman to establish such a works in a particular place will, no doubt, meet with disfavor for that very reason.

The Chilian Government is organizing an exhibition of mining and metallurgic machinery and implements at Santiago, beginning on the 15th of March next, and will transport free exhibits sent there from other countries. Being a Government undertaking, and by a Government competent for such an undertaking, there will

no doubt, be fair and encouraging methods with liberal conditions for exhibitors. This is a good oportunity for firms here who have specialties to be shown there. It is unfortunate as to being held during the same time as the proposed fair here, also as to the state of business in this country; still there are many reasons why various California inventions should be sent there, when the terms are so very favorable and inexpensive. We hope at a later date to give more information respecting this exposition.

The Union Gas Engine Company, of this City, have constructed a gas engine locomotive, that we must pronounce, after some examination, the only well designed and "rational" attempt of the kind yet made. The principal feature of the engine, in so far as its mode of operating, is the method of applying the driving power. In other engines or locomotives of the kind, the propelling power is so applied that when there is increased resistance from ascending grade or other cause, the engines "slowed down" just when an increased amount of power was required. As the power of an engine is directly as its speed, the result has been that these locomotives have failed unless provided with a wasteful excess of power. In the new engine above referred to, invented by Mr. D. S. Regan, of this City, there is no change of the speed and power of the engine, no matter what the resistance or the rate of movement on the rails may be, the engine goes on at its normal speed exerting full force on the driving wheels. Besides this there is an intelligent and complete arrangement of the machinery with about half the usual details and tackle omitted. This, if we mistake not, is an important advance in a much needed system of propelling street cars or any kind of rail traffic by means of petroleum engines.

COMMENTS.

The old word worn subject of how far one can become a mechanic in a school, has come up again through an article written by Professor Torrey, of New York. The discussion is not worth the candle, or speaking for our day, is not worth the electric current consumed in the reading. We have a very constant measure of the extent and value of school training without anybody's opinion, and

that is the estimate placed on diplomas by employers. This is the constant and infallible gauge. It may be said that there is in many cases a prejudice against school training when it is presented as a warrant of competency. There is but little truth in this. People are in such matters governed by their interests, and will employ those who can earn more than their wages. Discussion does not change the matter at all. The value of school training, and it is a good deal, is just as well known in mechanical establishments, as the price of iron or coal is, and like the coal and iron will continue to be bought at its real value.

Mr. Whitfield P. Pressinger, writes in the November number of the *Engineering Magazine*, of compressed air, enumerating its wide uses, which does not mean much in a technical way. The uses of almost any thing of the kind are wide, but the thing to be noted here, is the assertion that compressed air employed in raising water on the system of Dr. Pohle, attains an efficiency of 70 per cent. whereas that of a deep well pump is about 30 per cent. This is pretty good nonsense ; but the most striking part of all is that in one case a supply of 75 gallons a day was increased to 300 by the buoyant or air system, from which, and other things, we conclude that the author's connection with compressed air is through the medium of trade circulars. Such writing is cheap, or ought to be, and is only worth the price, because in this case the latest and most notable of examples in compressed air transmission are not mentioned at all.

Some of the ablest essayists, and let us hope honest men, have written of the American Senate in a way that causes thoughtful people concern. In one anonymous essay the leading Senators are divided into classes, and their names given. Class I are Senators of the old theory and traditions. Class II, professional politicians, who have procured their seats by "political processes." Class III, men who have seats because of their wealth. Class IV, oddities and accidents, men who by notoriety have attained their positions. This is not very hopeful and is certainly true, but the main fact of all is that this branch of the Government can be rendered inert, if not a kind of nuisance, when personal interests are set up against public ones. The late special session must remain a wonder, unless outdone by future ones.

The Gothenberg liquor law, or something very like it, went into force in South Carolina, in July last, and has had a marked effect in reducing drunkenness. The State, or its agents, sells liquors and beer under certain restrictions, so the trade is there made reasonable and respectable. This is the essence and aim of the Gothenberg system, or as we should say, the Scandinavian system, because the Norse application of it is more perfect than in Sweden, and drinking has been reduced in Norway 53 per cent. In Finland the result is much the same, while in Sweden as a whole, the effect has been to reduce drunkenness 35 per cent. In this country, and in England too, the connection between drink and politics raises a problem of how officers or agents can be selected to act impartially. Judicial appointments would be best, and the best might be very bad when a judiciary is elected. In England drinking is made respectable in a great degree by having women attend the bars ; this prevents rowdyism and vulgarity.

The *American Shipbuilder* contained, in a recent number, a portrait and some account of Mr. C. A. Griscom, of Philadelphia, the president of the International Navigation Company, that owns the Red Star Line of steamers between Philadelphia, Antwerp, and Holland ports, also the great Inman Line between New York and Liverpool. The International Company controls, as the *Shipbuilder* claims, "a large portion of the trans-Atlantic trade of the world" and how does it happen, one will wonder, that this great fact is almost unknown? Our answer is that under our beneficent navigation laws an American owner must, or does, sail his ships under a foreign flag and hardly dares to let it be known that he is an owner. The same thing applies here on this Coast, one line of steamers owned by our citizens is sailed under the puissant flag of Hawaii. This is a queer method of encouraging American shipping. Mr. Griscom in any other country would receive proper recognition for his enterprise.

Mr. Lloyd Wise, the well known patent agent in London, read a paper on the subject of "Patent Laws" at the World's Congress of Patents, at Chicago, on October 6th last, in which he suggests substantially what we have done a number of times in this Journal, namely: That official examination should not involve the power of "rejecting" an application, when the allowance of a petition gives no guarantee of validity. He suggests that an applicant

should be called upon to disclaim and amend to meet any references given, and should, as he takes all the risk, decide if he wants the patent to issue. That the power of rejecting cases does not lead to valid patents is sufficiently proved in this country, where legal contests over novelty are more frequent than where no system of rejecting exists, and where the applicant himself elects as to the issue of his patent with its record. Another suggestion of the author is that the term of a patent should depend on annual payments, the aggregate of which should not exceed present fees. This would be a means of weeding out inert and worthless patents and preventing some serious abuses that now exist.

By an erratic wave in the financial department we were able to dine recently at a French restaurant, and made it the occasion for some thoughts on the waste of food in this country. What a terrible fact it is, that at least a half of the food served at hotels and restaurants in the "American style" is wasted. It is a mockery of apppetite and digestion too, to be served with a pound and a half of beef or other meats in one course, and nothing to follow, without paying for another meal. The whole system of American restaurants seems to be based on the idea of hunger and impecuniosity, with a saving of attendance. Any one or two courses makes a meal, and as many trips for a waiter. More than this is considered display, and calls up a long bill for food wasted. In the restaurant at first alluded to we discovered an improvement—a reduction of quantity and an increase of quality. One can eat as much as is served, and therein lies a satisfaction. The French may not know how to colonize, but they can cook.

A timber journal in Buffalo, N. Y., has discovered that the balance of mankind are irresponsible demagogues, and that the "figures are all wrong." That the producer is constantly giving away his profits to his workmen. We have not read the article very carefully. It would be a waste of time. Here is a quotation: "The producer who received $100 for a given amount of these articles (food, fuel, metal, etc.), in 1840, received in 1890, after half a century of investment and experiment, only $93.60 for the same amount." One would think that if he received one half the amount in 1890 there would be a fair chance of his profits being greater then. In many products the values changed as from four to one in this period. But this aside, we think that a comparison of cost on

sale prices with wages in 1840 with 1890 is the most remarkable economic proposition presented to this time. That wages increased is but natural. It is the writer's assumption that during the time when human wants and requirements have vastly increased, such increase pertains only to those who employ labor, the workman himself having no right or part in new wants and comforts.

The number of seal skins taken during the past year, U. S. Consul Meyers, at Victoria, B. C., estimates at 100,000, which means the slaughter of not less than 200,000 seals, if accounts of the methods are correct. The extermination of the fur seal tribe is only a question of time, and a short time, under the incentive of $12.00 to $15.00 apiece for the skins. The murder of animals by mankind is fiendish, and a lucrative price for their pelts is the doom of a species. The buffalos afford an example. We can remember when in any Western or Southern city a buffalo "robe," meaning the hide tanned with the fur on it, was worth $1.50. Now the same thing, if attainable at all, would be worth $40.00 to $50.00. Of course no buffalo could last long under such a bribe as that for his destruction.

The Twelfth Annual Convention of the American Street Railway Association met in Milwaukee, Wis., on the 18th and 20th of October last; the attendance was about 600. The proceedings included various technical papers, a business report and a banquet. The resources for the year were $89,663.77 and the expenditures $6,541.48, which indicates the extent and importance of the association. The membership seems to be made up of street railway companies, as well as individuals, and of course has in this way resources not common to such organizations. The proceedings, or work of the society, deals with all that pertains to street railways, technical, legislative and economical. It is a vast interest that has managed to exist without much antagonism in all the cities of the union, although more nearly and intimately connected with private interests than the commercial and inter-state lines are. The management is more responsible, being in most cases in the hands of citizens and the corporate property under control of municipal authority. The fast changing methods of propulsion now occupy a foremost place in the deliberations of the society above named.

All over the world there is an epoch of imbecile and vindictive administration. The legislative function seems to have been swallowed up in men's passions and foolishness. Russia and Germany are contending with each other to destroy their commerce, like two children. Brazil's president has undertaken the role of a dictator and provoked civil war. Italy is bankrupt in trying to emulate other great nations with an armament that may prove her destruction. England has her two legislative bodies in conflict, and the United States is trying to make money by law. The Democratic President is being anathematized by his party for not being a politician. Sweden and Norway are contending, and a war in Europe is portended by alliances and fireworks of one kind or another. The great changes wrought in the social conditions of mankind are half a century ahead of law-makers and the governing element, which is going backward instead of forward.

ENGINEERING NOTES.

It requires 1,100 horse power to supply the new station of the Boston and Maine Railway, at Boston, with the required current for lights and for other purposes. The machinery will be made by the Westinghouse Companies, the engines being directly connected to the dynamo in the well known style of that company. There will be 4,000 incandescent lights for interior service at the station. Salt water is available for condensing, and the Bulkley type of condensers will be employed. The draught of the furnaces will be caused by fans, the chimney being only 55 feet high, and in this feature is a novelty that will be watched with interest. The draught is in this way placed at absolute control, and the expense of a high chimney is saved.

It is not commonly known that a vertical ladder is more easy to ascend and descend than a leaning one. Our attention was first called to this fact in the irrigation pits in California. These are from 30 to 60 feet deep, sometimes more, and are sunk so the centrifugal pumping machinery can be placed within lifting distance of the water, which is obtained from bored wells in the bottoms of the pits. A vertical ladder leads from the top to the bottom, with spaces of about 20 inches between the bars. It is less labor to go up or down

one of these ladders, 60 feet, than it is to go 30 feet on a leaning ladder. The reason is that both the arms and legs are brought into use in raising or lowering the body. The arms alone are almost incapable of raising one by steps or stages, and the legs tire out at 20 to 40 steps, but arms and legs together can easily make one hundred steps, or lifts, for a strong person. A slight inclination is better than vertical, but is not easily obtained, and the vertical ladders answer very well.

Some of our readers will remember the criticisms passed upon the machinery of the cruiser *Chicago* when she was built about nine years ago. She was fitted out with brick furnaces, modified beam engines, and a lot of other novelties that traversed common practice of the time, and now after eight years of service at a speed of eight to eleven knots an hour, she must be stripped of everything in the way of motive power, and rebuilt at a cost of nearly half a million of dollars. There should be some way of keeping personal "fads" out of the public service and the treasury, and the best way to do this is to see that a competent chief officer presides over the Bureau of Steam Engineering, such a man as the present one, who has the good judgment and practical knowledge to make him conservative. We have had no "fads" for six or seven years past, being happily rid of them by the appointment of Commodore Melville, as chief of the Bureau of Steam Engineering.

The American makers of band-saw mills having now developed about all the "kinks" and requirements of these important implements should begin to design them in some form that is not offensive as to symmetry. These machines, as now made, violate all the ethics of design, and unnecessarily. The strains are tolerably constant, a good deal more so than in most other machines, and fall in nearly true lines, but the framing and main members of the machines have about as much symmetry as a brush pile. The small machines were at first equally as bad, until Richards, Thorne & Co., of Philadelphia, in 1870, produced what they called the "G frame," that formed a throat for the timber, and graceful curves met all the points of strain and support. These machines have since been copied all over the world, generally with some modification in this country, where the design was patented. The band-saw mill needs reforming in the same manner.

Engineer Jones, of the salt water department of N. P. C. Railway Company, who is an old veteran in various kinds of service, tells an amusing story of twenty-five years ago, when he was in the New York aud Panama service. The engineers wanted the skipper to take down the yards and stow them on deck out of the wind. "The sails," said engineer Jones, "were a nuisance. If the wind was on the beam we laid over with one wheel in the air. If it was abaft we ran away from it." The skipper contended that to lower the yards would disfigure his vessel, besides four knots of speed must be counted to the sails with a fair wind. The argument went on, until one day an accident disabled the engines for a time. There was a fair wind, and all canvas was set, with a result of less than two knots an hour. This "settled it;" the yards came down, and as engineer Jones asks, "Where are the yards now?" "Canvas is no good mixed up with a steam engine. It belongs by itself at sea, otherwise belongs ashore."

Admiral P. H. Colomb, of the Royal Navy, Great Britain, has written for the *North American Review*, an article on "Battle Ships of the Future" that, taken as a whole, is a claim that the round of modern inventions in war ships are outgrowths of mutable notions, conceits and fashions, and that there is no science in the matter. These are not the Admiral's words, but an inference from his remarks, and is a confirmation of preconceived opinions. The changes, if nothing more, in naval armaments, are enough to show that there is not even one single principle that is determinate and settled. The only permanent thing the Admiral can discover is a battle ship, and this not because of her construction, but her place in defense and the analogy to a fortress. The surest way out of the present dilemma is for the different nations to stop expending money on war ships, and devote it to some more rational and humane purpose. A compromise would be cruisers arranged for commercial uses and convertible for offensive purposes in case of war.

A discussion has been going on in the *American Machinist* over the problem of supports or legs for machine tools, especially lathes, and from it one would think that this old subject, "thrashed out" twenty years ago by Prof. John E. Sweet and others, could be laid to rest, but here it comes up again, and in a form to indicate that the writers are at the beginning, or have hardly arrived there,

because the form of legs is discussed independent of the nature of the foundations on which they stand. The American form is right for a floor, and wrong end up for an inflexible foundation. The English form is just the reverse, right for a masonry foundation and wrong end up for a floor. It all depends on whether a foundation's rigidity is to be communicated to the frames. No one seems, however, to consider that four supports on any but an inflexible foundation is wrong in any case, and that there should be three bearing points. This Professor Sweet once pointed out by referring to a three-leg stool that always stands firm, each leg taking its proportion of the weight.

People are sometimes puzzled to know why "induced draught" is not employed instead of "forced draught" for steam furnaces. It seems the same thing, and is, if we consider only the passage of a current of air through the grates and fire, but there is another condition in the case. By a forced draught or a closed fire room, as it is commonly called, the air is compressed in volume, while with induced draught the opposite takes place, the air is attenuated. The compression of air in furnaces is, we imagine, to receive more attention in future, where forced firing is expedient. If means are employed to create an artificial draught a chimney is of no use for that purpose, is indeed an objection in so far as creating a draught, and can be limited in height to what is demanded to carry off the smoke and spent gases. A plant, now being erected in Boston, Mass., on this plan, has a chimney extending only a short distance above the roof of the buildings.

Another railway tunnel is to be bored through the Alps, twelve miles long, for the Jura-Simplon Railway, to be called the "Simplon" Tunnel. The contract has been let to two firms, one in Hamburg and the other in Zurich, both of which have had experience in such work. It took 13 years to make Mont Cenis tunnel, at a rate of about 15 feet each day of 10 hours, at a cost of $1,130 a yard, or $376.66 per foot. Before completing the work the air drills and other improvements doubled the rate of the work and reduced the cost to $241.66 per foot. The Arlberg tunnel was bored at the rate of 27 feet a day at a cost of $180 a foot. The new tunnel will be made at a much lower cost, no doubt. The time for construction is set for 66 months, and the cost at about $11,000,000. It seems

strange to read of the preparations of such commercial connections, and at the same time of the preparation for war between the trans-Alpine countries. It is to be hoped there will be tunnels enough there some day to prevent war.

A twenty-ton fly wheel, one out of three that have recently failed, went to pieces at a power station in Brooklyn, N. Y., in October, wrecking everything in the vicinity. There were various conjectures respecting the cause, but not among the explanations any mention of the fact that such wheels are driven close up to the factor of safety. The Government imposes tests of certain steam boilers, and were it not for the paternal idea of such regulations there is equal reason for some kind of restriction on the speed of cast-iron fly wheels. It is seldom on this Coast that makers of steam engines approach the 80 feet per second limit, but we found one case recently where a wheel, and a dangerous-looking one at that, was running nearly 100 feet a second on the rim. It was an Eastern made engine, with a gait fixed by competition no doubt. Cast iron in the hands of any but skilled and conscientious foundrymen is a treacherous material for wheels to be driven at the speeds now common, and our advice to those purchasing engines is to stipulate for a speed test of doubtful wheels at the risk of those who furnish them.

We have, for three years past, urged with such force as a journal can employ, the attention of steam engineers to the impulse form of engines. The successful application of this principle to water wheels, on this Coast, should contain a hint in respect to steam. At this time the development of impulse engines seems to be in the hands of Dr. Laval, of Sweden, the Hon. A. C. Parsons, in England, and Messrs. Dow, of Cleveland, Ohio. We mean in respect to both practical and scientific treatment of the subject. There have been many impact engines, from that of Hero down, but until the injector opened up new laws respecting the power of vaporized fluids, there was only experiment of a discouraging kind. In the Parsons and Dow engines the steam is applied under high pressure and expended while acting, while Dr. Laval, who seems to have the best of it just now, expands the steam down to the atmosphere before applying it on the wheel or engine. Both he and Mr. Parsons are close behind the common expanding steam engine.

The new engines on the Corliss plan, made for the Paris Compressed Air Co. by M. Schneider & Co. of Cruesot, France, are four in number, of 2,000 horse power each, triple expanding and condensing. The specifications contain many conditions that will seem risky, but there is little fear of mistake with that famous company that employs 15,000 men. The guarantee of fuel was 1.54 pounds per hour, of briquette coal for each horse power, trials to last for eight hours or more. The initial steam pressure is 150 pounds per inch, generated by water tube steam boilers. The air pressure operated against, is 144 pounds per inch. One trial of these engines took place in January last, all observations and data being taken in duplicate by two sets of engineers. Diagrams were taken from each cylinder every half hour, and the springs tested each time a diagram was taken. The horse power during these experiments was 1,996, for each engine, and the coal consumption only 1.29 pounds. The proportion of work done on the air piston was 90 per cent. of that on the steam pistons. This result is, no doubt, in advance of any other up to this time.

Mr. Ferris, the Pittsburg civil engineer, who designed the great wheel that bears his name, now proposes a more permanent work of analogous nature, a cantilever bridge across the Ohio River at Cincinnati, Ohio, with a clear span of 1,800 feet. This will be 900 feet of projection, so to call it, and much more of a feat than building a "tower" of that height, or twice that height, one may say. "Cantilever," in a technical sense, means a projecting lever balanced, or nearly so, on a fulcrum or pier, the load thereon representing a "canting" force; in other words, a flat arch with coherence enough to stand with but little aid from the "key stone." Such bridges are commonly compound, partaking of both the principles of an arch and lever. At Cincinnati the variations of level in the river are more than 60 feet, and a hundred more is required for steamboat chimneys.

A notice and drawing of a new Tee-square, with some kind of an adjusting head for angles, one device out of dozens that have been proposed and adopted, admits of the following comment: A Tee-square head needs no adjustment. It should be solid—as solid as possible, and if diagonal lines are to be made a separate square should be employed. All these adjustable double function squares are a snare and a delusion. No good practiced draughtsman fools

with such things in machine work. There is never any assurance that any "adjustable" thing is true, and it is in the line of machine combinations, that are much the same as machine abominations. What we require at this day is "separation" in both machine and hand implements, and our recommendation is, to not only provide fixed and movable squares, but separate instruments for pens and pencils, and spend no time in adjusting, converting and changing anything when avoidable.

Col. T. C. Mendenhall, superintendent of the U. S. Coast Survey office, and of weights and measures for the Government, announced at the Engineering Congress in Chicago, on August 1st of this year, that the Bureau of Weights and Measures, with approval of the Treasury Department, would from April 5th recognize the meter and kilogram as fundamental standards, and the English yard and pound as derived therefrom. This is the official adoption by the Government of these units, and will to some extent promote their inevitable acceptance at no distant date in this country. The kind of patriotism here and in England that urges the retention of irrational units of measure, just because a better system originated elsewhere, is of that cheap kind that commonly has notoriety for an excuse. Some of the arguments in favor of the English system of lineal measure, especially in that country, are as illogical as Mark Twain's dissertations on scientific subjects—the length of the Mississippi River, for example.

It seems strange to find long dissertations on the best way of supporting water wheels on steps beneath them, and very little respecting the resistance of end thrust of marine screw shafts. Tradition has left us the legacy of a "locust block boiled in tallow" as a means of supporting a water wheel, and it seems impossible to abandon the idea, mainly, we imagine, because it is cheap, and the maker of water wheels in this manner avoids the expense of providing proper means of sustaining his wheels. If we mistake not, Uriah Boyden supported his famous Fourneyron wheels, at Lowell, Mass., by thrust collars above the wheels, with only lateral guidance beneath. These wheels have been in use thirty years or more, and it is about time that the wooden step was relieved of weight by more effective and accessible means of taking the thrust. The makers of marine engines have gone through all the various contrivances to resist thrust, and have settled down to where theory

points, namely : The surfaces that receive pressure should move at the same, or nearly the same, velocity over their whole area.

The Willan's single-acting compound engines, shown at Chicago, will, no doubt, bear fruit in suggesting improvements in this country, especially in respect to electric stations where a number of engines and generators are employed. The custom is with these engines to perform regulation with one of a series, leaving other engines to work at a constant load, and whenever the quantity of current will admit it, cut out one engine, taking the next one to govern or provide for variation in resistance. Whether this has been done in the case of other high-speed engine plants we do not know, but it seems a very excellent system in so far as the economy of steam, and in uniformity of speed. In any cases where close regulation is required it might be a good arrangement to provide a special auxiliary engine to take care of the variations of load.

In a recent biographical notice of William Murdock, the inventor of gas lighting, and Boulton & Watt's main assistant, it is claimed he made a rotary engine that "ran for thirty years and worked well." If this is so it was a misfortune, because of encouraging a numerous progeny, most of which will not run as many days as Murdock's did years. At Murdock's time there was no such knowledge as exists now respecting the difference between rotary and reciprocating engines, still not one inventor in twenty, perhaps not one in a hundred, considers the difference between variable and uniform velocity in sliding joints. If the bearing surfaces or steam joints, so to call them, in rotary engines moved at an uniform speed upon each other, as the pistons of reciprocating engines do, Murdock would have another foundation for fame equal to his gas-making discovery. We can, however, hardly expect that he could have discovered this.

ELECTRICITY.

NOTES.

Mr. A. E. Dolbear, in speaking of the new process of electric heating discovered in Germany, says :

"The commercial importance of this process appears to be considerable. For instance, a blacksmith could dispense with his forge, and have substituted for it a tub of soapy water, with a carbon plate a foot square permanently immersed in it, which could be switched into a common incandescent light circuit, and a pair of tongs, properly insulated, also connected, by a flexible conductor, to the same circuit. With these, a rod of iron, say half an inch in diameter, can be raised to a welding heat in ten or fifteen seconds, at the cost of three horse-power for that time."

If these "quantities" are correctly given the commercial fact is more than important. It is revolution.

It has been claimed recently in technical journals that the Americans, while fully up and in advance in most branches of electrical science, were far behind Europe in storage batteries or the accumulator system. This may be true, and indeed must be admitted in respect to the use of such batteries, but is not likely to remain true much longer. There is a wide activity in the direction of electrical storage batteries, all over the country, and some very important features have been recently added in this City, also experiments conducted in respect to street propulsion that promise well. On the whole there is but one discouraging feature in the matter of accumulator batteries, and that is the slight divergence that many years of investigation has carried the art beyond where Faure left it, and that peroxide of lead has remained almost alone the only active material for such batteries discovered to this time.

One of the Edison Electric Stations in New York has been fitted out with storage batteries to equalize the load on the engines and generators, a method applied in a great many cases in Europe. There are 140 cells, weighing 750 pounds each, of 1,000 ampere power. The cells are 48 $\times$ 21 $\times$ 15 inches, and the discharge from the battery has a normal rate of 200 amperes and a possible rate of 500 amperes. Mr. C. O. Mailloux, at the late Street Railway Conven-

tion in Milwaukee, exhibited diagrams showing the fluctuations between the generative and stored supplies of current, in which for a given term or period 23.2 per cent was drawn from the storage batteries. In another case, some months later, when the generating plant had been increased, showed a reversal of the circumstances. The two sources work together in various relations and with results we have not space to describe. It is a very interesting study for electricians.

Electric Power lectures the authorities of the State of New York for not doing more in respect to electric towage on the canals, than permitting their use for experiment. This all depends upon whom the experiments are to benefit and whether electric tolls go into the State treasury or into the treasury of some company who may secure a "franchise." The "ultimate benefit" doctrine, so well understood on this Coast, has ceased to allure tax payers. Such benefits seldom materialize in any form that will support schools, make roads and maintain justice. Indirect public benefits are becoming a myth. The ingenuity and activity of corporate and private interests is such that the public, operating through the machinery of State Governments, is sure to stand in the position of the proverbial monkey who raked the chestnuts out of the fire; besides the State of New York is not in the way of making experiments.

The electric trolley railways in Brooklyn, New York, have assumed immense extent. One station there has an ultimate capacity which at present foots up 18,000 horse power, consisting of compound steam engines of the Corliss type, 2,000 horse power each. The main steam pipes, leading from the boilers to the engine room, are twenty inches in diameter. There are economizers, condensing apparatus, and all requirements of the time. In this connection we will call attention to the wonderful advance in steam engineering, called out and made necessary by the requirements of electricity. It has not only brought into use types of engines not known or required before, but has raised the efficiency of standard steam engines in a wonderful degree, calling in the highest skill to compete in an uniform class of duty. Emulation can not exist when the circumstances are diverse, but lighting and power plants are so nearly alike in their object everywhere, that it calls out a strife for excellence and high results.

Mr. F. L. Pope, in the electrical notes of the *Engineering Magazine*, has the following :

"One of the longest electric railways in the country is that from Oakland to Hayward's, California, a distance of fifteen miles. The cars on this road make a speed of 35 miles per hour, and the distance between the termini has been run in 35 minutes. Some of the cars run an average of over 200 miles per day. Great care is taken in respect to the inspection and repair of the motors."

One of the late and much needed inventions in electric apparatus is a lamp that in power is between the arc and incandescent types, or in other words, a gap has been filled in between high and low power lamps with one that can be served with either a direct or alternating current. This last fact is also important, because it places electric lighting at direct control without clusters of incandescent lamps, or the objections that apply to open arc lights. The construction, as we understand it, can be described as an enclosed arc lamp, wherein the carbons are in a vacuum ; but however it is made, it will, if successful, fill a want in lighting.

Some pages of matter have been written respecting a "pull" between a steam and electric locomotive at Chicago. It was amusing, no doubt, but had to mechanics no meaning whatever. It may have pleased the "Grangers," but was merely a question of weight and "torque," and if both engines could slip their wheels, it was merely a question of weight and "sand." The best way to dispose of the matter is to consider it as belonging in that department called the "Midway Plaisance," devoted to diversions unconnected with mechanics and machinery. The 1,000 horse power electric locomotive, now being constructed at Philadelphia, will no doubt "pull back" any steam machine that can be attached to it, and that will prove just as much as the experiment at Chicago. This engine, designed by Sprague, Duncan & Hutchinson, is for switching, or, as the English call it, "shunting," or yard duty. It will be a good deal the largest ever made.

The *Railway Review* protests against the hammer and tongs methods of telegraphy. It is absurd, and worse, to hammer out messages in public places with a Morse instrument that can he heard and read by anyone familiar with thc code, and that means a great

many people nowadays. The American people have clung to the Morse system despite its many faults, but are now compelled to give way to the Wheatstone method because of speed, and let us hope because of silence. In the latter system a tape of paper is punched with the message the same as if it were written. "Sending" consists in running this tape through the "machine." The paper is a permanent record, and the message can be sent any time and repeated at pleasure, besides is reproduced in the same way. Five hundred words a minute can be written, or punched, by using some abbreviations, and some expert operators have reached nearly 1,000 words a minute. The press matter has for some time been transmitted on the Wheatstone system here in San Francisco.

MINING.

NOTES.

Johannesburg, in the Transvaal, Africa, has at this time a good many of the characteristics of a mining town, but without the ready pistol, so common here. The output of gold last year was a million ounces, and is estimated much higher for the current year. Hamilton Smith, the well-known engineer, has been out in the gold mines there for three months, and on his return to London expressed the opinion that within three years the Rand ledge will yield $50,000,000 a year, and that the total yield from the whole of the main reef will reach $500,000,000. These seem wild figures, and are bewildering. There are 35,000 Kaffir negroes at work in the mines, a drunken inefficient kind of laborers, but cheap in proportion, receiving about $15.00 a month.

The proposition of Mr. A. M. Ransom, of San Francisco, to build retaining dams for mining debris from the debris itself, seems one of no little importance. It has recently been described in the *Mining Press*, and consists in depositing the material in suspension at the lower end of an impounding basin, and flowing the water back to the upper end from where it will escape beneath the dam, so the "front" is being continually built up with the sand and "slickens," precipitated at or near the dam's crest. The present method is to flow the debris into the upper end of the basins, where the solid

material settles and the water goes on to the dam where it escapes. Mr. Ransom reverses the operation, forming a constantly-increasing barrier of the settling material. It is difficult to see why this will not succeed. Of course an under flume will call for some expense and attention, but nothing like that of building a dam up to the top of the intended fill.

Our readers will remember a sensational report of some time ago respecting a large amount of valuable ore in the Con. Virginia Mine, known to J. H. Rule, who, for a consideration or a share, we do not remember which, was to disclose this ore. The mine was opened up on the last day of October, and preparations made to investigate the existence of this ore, supposed to be a little below the 1,000 feet level. It may be a ruse to influence the price of shares, because down to this time no discovery is reported. The shaft and other parts are being repaired, indicating some additional activity, but no report has yet been made of Mr. Rule's bed of ore at the 1,000 feet level.

The African Colonies, or States, they should be called, now seem to be especially prosperous in these dull times. The recent discovery of coal veins of great depth, in the Orange Free State, is a piece of good fortune for that country. The particulars are not well known, but there is no doubt of the finding of coal. In the Transvaal one mining company, the Durban-Roodepoort, had seventy stamps at work, crushed in September 6,775 tons of quartz, yielding over 5,000 ounces of gold. The Ferreira Company, in the same State, exceeded this during the same month. This seems fabulous, and should call the attention of the makers of mining machinery here to such a market as this. Africa is the traditional land of gold, and just now gives promise of a great expansion in that interest, especially in the Transvaal, or South African Republic.

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